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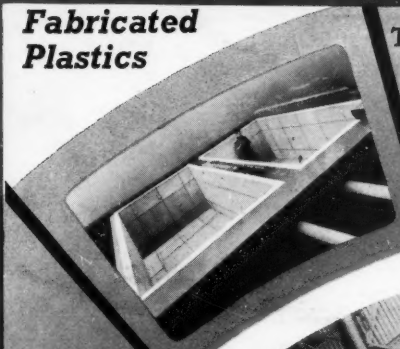

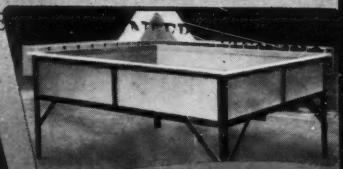

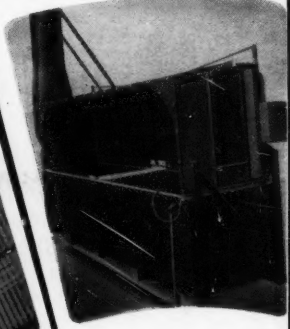

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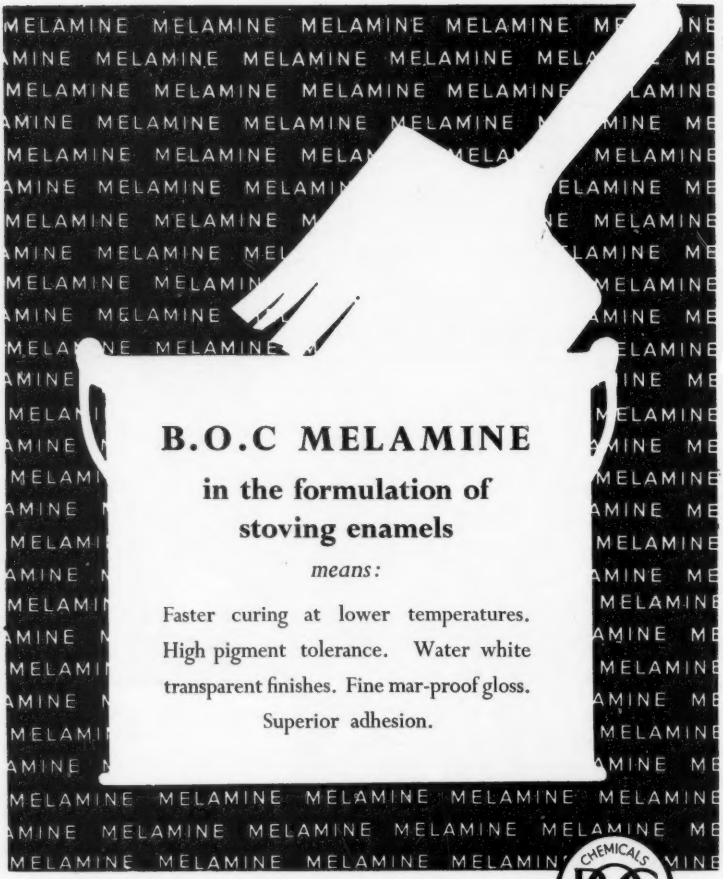

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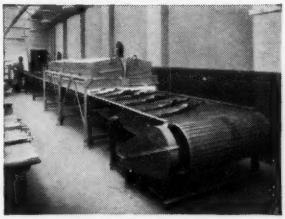

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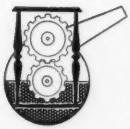

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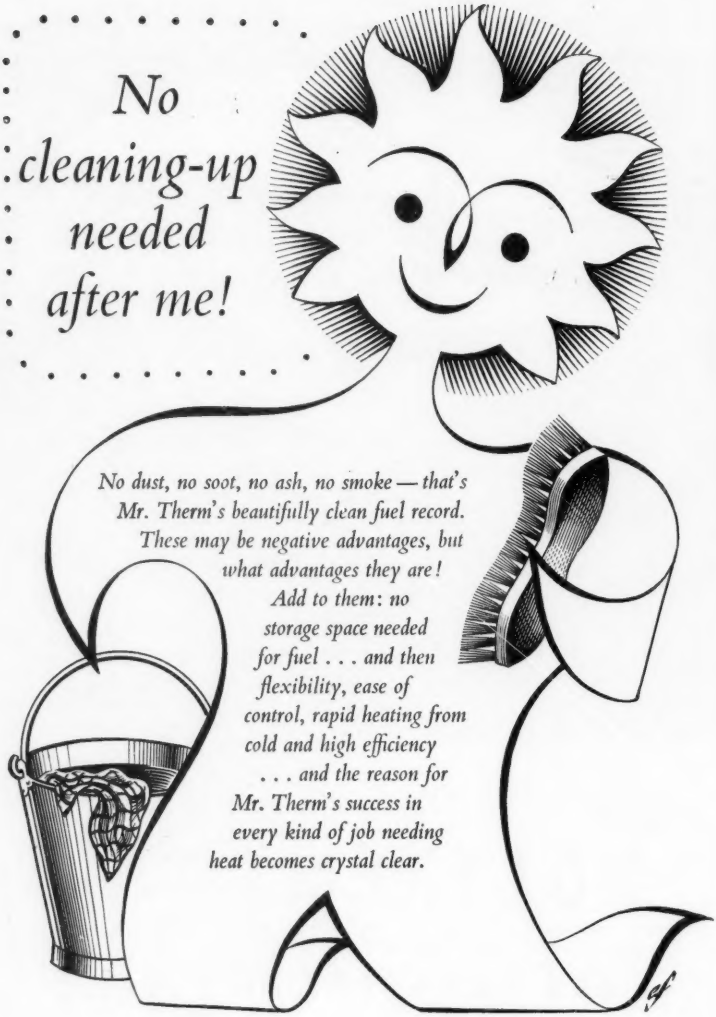

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Techniview, 12.6.52.

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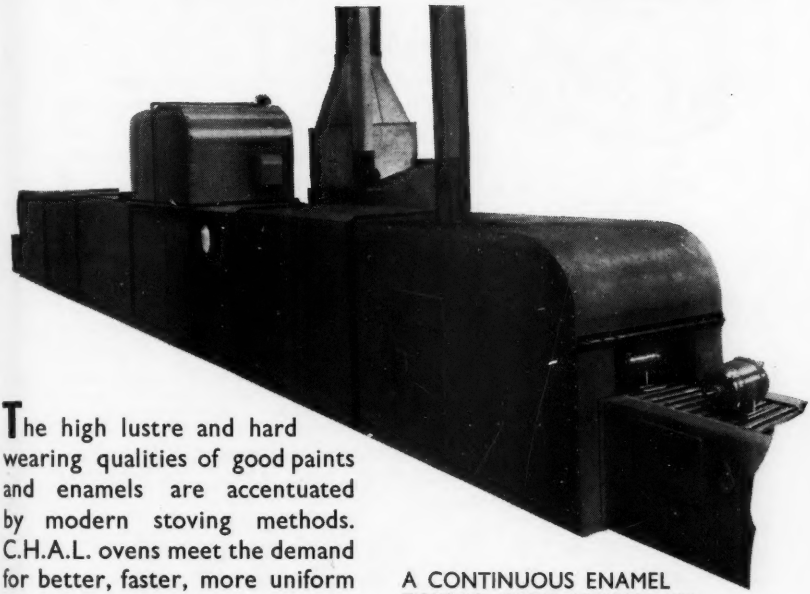

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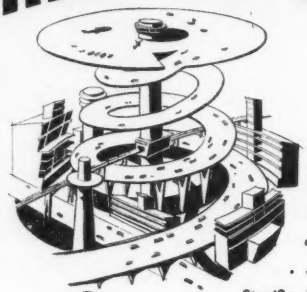

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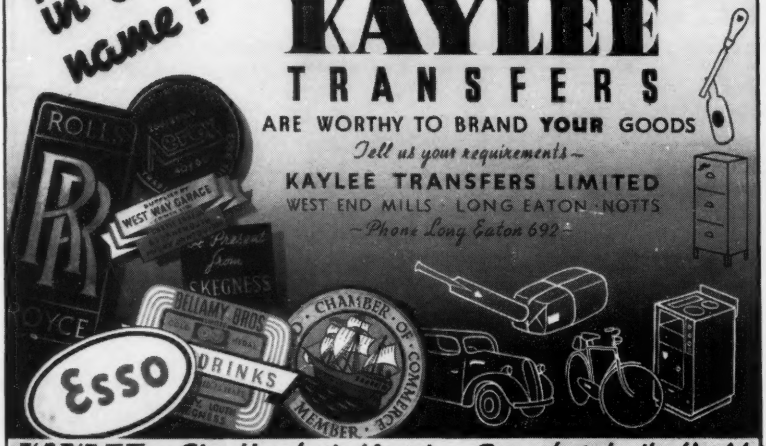

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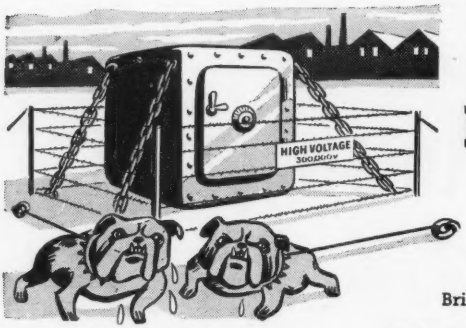

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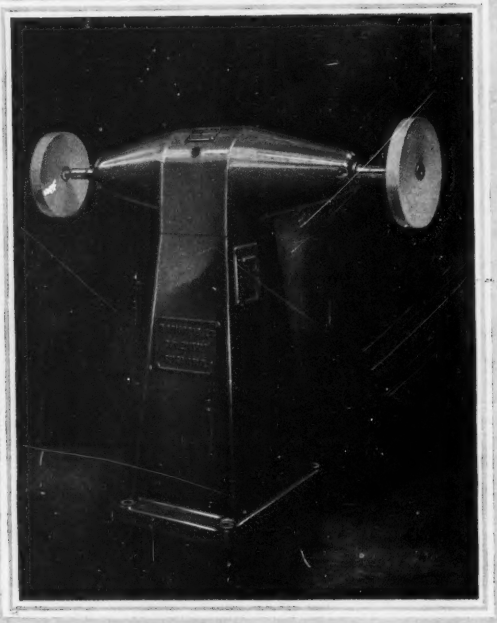

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INDUSTRIAL FINISHING

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DECEMBER 1952

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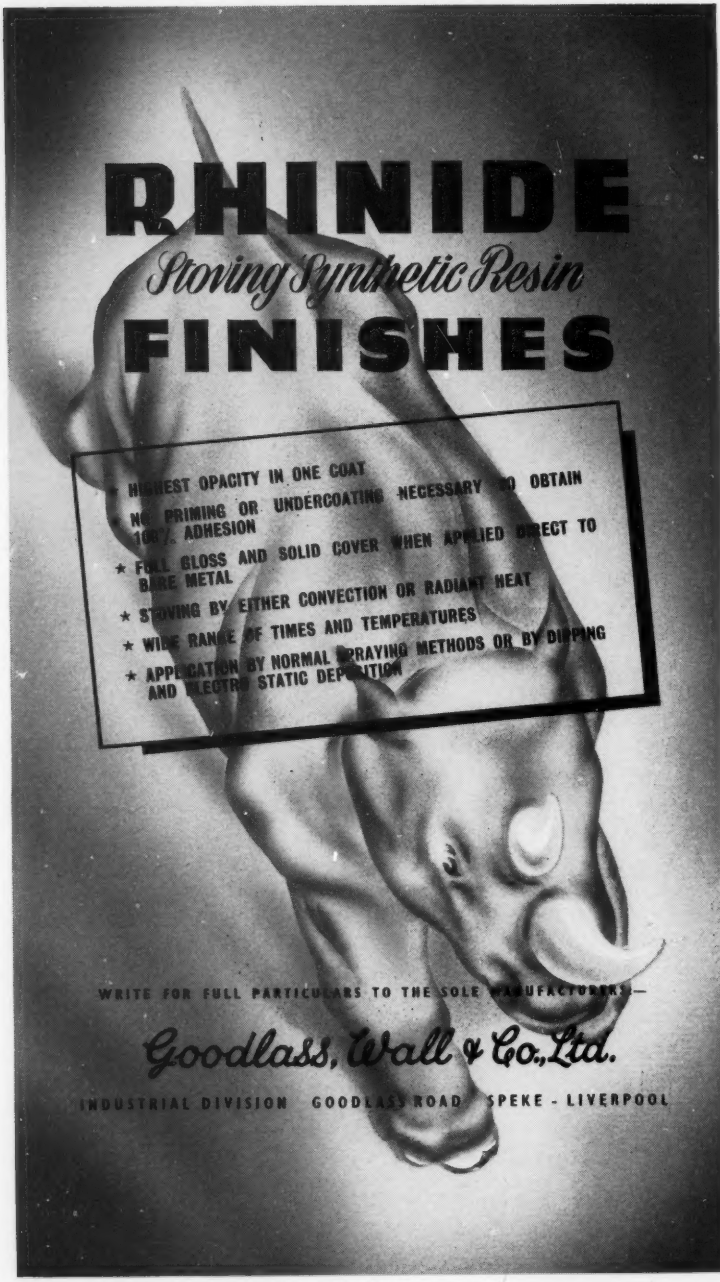
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Industrial Finishing

VOL. 5 DECEMBER, 1952 NO. 54

Technological Universities

OVER the past year or so INDUSTRIAL FINISHING has taken a lead in stressing the inadequacies of our existing facilities for training students in the technologies. It has been stressed by the Editor how the universities have a background which fits them to train students in pure science, but that the universities are largely divorced from manufacturing processes.

Opening an exhibition at the Science Museum recently to mark the centenary of Sir William Ramsey's Birth, Lord Woolton, Lord President of the Council, said that pure research work has led to vast developments of our industrial life. Lord Woolton continued:

"In so far as discoveries have been applied to industry in this country we have been fortunate, but much of the work of British scientists has not been applied in this country, because of our failure to train, and to absorb into our industrial life, chemical engineers and applied physicists—these practical scientists whom we have come to call 'technologists.'

"The high efficiency of the industrial life of this community is the essential counterpart to our standard of living, and if, in the face of world competition through the application of the vast scientific discoveries of the current age, we are to get the national benefit that fundamental scientists are offering to us, it will be necessary for us to alter our practices, and to create, in this country, technological universities with the status, and the distinction, that is given to our existing universities: and, through them, to train a race of people who will see that the successors to the great scientists whom we honour today, meet with the encouragement, and the rewards, that are proper for the services they render to the community."

It is pleasing indeed when one can begin to see the results of pioneering a cause taking tangible shape.

TROUBLE—ORGANIC FINISHING AND THE INSTITUTE

by **ARGUS**

WRITING in the November issue I began by saying that, "I will probably be a wee bit unpopular. . . . " How true, indeed! At the outset read this letter from the President of the Institute of Metal Finishing.

SIR—It is evident that "Argus," in your November issue, seems to be greatly dissatisfied with the Institute of Metal Finishing and all its works. Your contributor is, of course, free to hold and express his opinions, and with these the Institute is in no way concerned; it is an independent body answerable only to its members for its actions. There are, however, a number of factual points upon which "Argus" should be enlightened, since he is apparently unaware of the essential aims, functions and constitution of the Institute.

In the first instance, the council of the Institute is elected by ballot annually; any member can stand as a candidate and only needs to be nominated by six other members. The Council itself makes no nominations and there is, theoretically, no reason why the entire Council should not consist of members interested primarily in organic finishes. The Council cannot "co-opt into itself a number of nominees representing the organic side of the industry" as such action would not only be unconstitutional but would be open to serious objections. Co-option is only possible if there are insufficient nominations to fill available vacancies. The lack of representation of organic finishing is simply due to the absence of appropriate nominations to Council. It is true that, at the moment, the greater part of the membership of the I.M.F. is primarily concerned with electrodeposition. The effective broadening of the Institute's range of activities cannot be achieved overnight; it will probably take years before organic finishes are represented as fully as they deserve on the Council, but the rate at which such representation develops must depend largely on an increase in the number of members concerned with organic finishing. So far, there is little evidence of any interest on a substantial scale, although it is hoped that it will come. This does not mean, however, that the Institute is masquerading under a false title, as "Argus" seems to think. Perhaps some of your readers may have observed that your own esteemed Journal, for instance, normally devotes a very small proportion of its space to electrodeposition despite the comprehensive nature of its title. You may, incidentally, be interested to hear that at the Spring Conference of the Institute at Harrogate an entire session is to be devoted to organic finishes.

The organic finishes meeting to which "Argus" refers has already been arranged; the fact that this has not been done earlier is due to heavy pressure of work in many other directions on the Council and Honorary Officers of the Institute. Perhaps, it is not generally known that the Institute has not a single full-time executive officer, and no full-time paid staff. All the work which is carried out on behalf of the industry as a whole is freely done by people who give their time and energies to the task entirely voluntarily; they do not even receive out-of-pocket expenses. The actual cost of the publications which members of the Institute receive is greater than the annual subscription, and the financial strain of maintaining the rate of publications in face of ever increasing costs, is a constant source of anxiety to the Council. Many of these financial difficulties could be readily overcome if the Institute were prepared to forgo its independence, but this the Council is unwilling to do. It is a little ungracious, to say the least, for your contributor to castigate the Honorary Officers for what he considers to be their dilatoriness, but he should recognise that they have only a limited time to devote to the affairs of the Institute, and they all have other important jobs to do and their livings to earn.

So far as the Inaugural Banquet is concerned, the Council regards this as having been a wholly successful function which it is, furthermore, proposed to hold annually. Many invited guests and

others could not attend owing to the fact that an important civic function was subsequently fixed so as to coincide with the date of the banquet, but even this did not detract from the occasion.

The remarks of "Argus" regarding evening dress seem to be pure demagogy. Surely, in this day and age the wearing of evening dress is no longer the privilege of the landed gentry. No one would have been prevented from coming to the function because he was not in dress, but it is not unreasonable to request that those attending a dinner of this nature should be garbed appropriately. There is no evidence that any substantial proportion of the membership of the I.M.F. prefers to attend evening functions in lounge suits, as "Argus" would readily see for himself if he cared to attend the Institute's local functions where dress is always described as optional.

Finally, I would emphasise that the Institute's chief function is publication and the dissemination of information. It provides the facilities and a forum for all those interested in metal finishing at its branches throughout the country, and has no axe to grind. Cordial relations have in the past been maintained with the press, because the officers are always available to give any information that the press requires, if it is asked for. To issue "statements" to the press is unnecessary, since the membership is aware of what is being done at all stages through the medium of the branch committees and the I.M.F. Bulletin.

Comment

One or two comments, of course. The barb, "Your own esteemed journal . . . normally devotes a very small proportion of its space to electrodeposition." There is indeed thanks.

Trouble to look back only as far as June, when our whole issue was devoted to the Institute of Metal Finishing Conference. Members wrote in large numbers thanking INDUSTRIAL FINISHING for its first Conference issue, and looking forward to an expansion of the Conference number in 1953. In one fell swoop there is practically 1/12th of the INDUSTRIAL FINISHING editorial pages devoted largely to electrodeposition, if nothing else is added. If that June issue is handy on the shelf just check up—and rest assured that the INDUSTRIAL FINISHING Conference number for the Institute will be even more comprehensive in 1953.

Factually, however, there was a meeting called by the Institute on organic finishing early in 1952, and a Conference was promised in the Autumn of 1952. When the November comment was made the trade and technical press had no information as to when the Conference was likely to be called, nor indeed had anyone troubled from the Institute to explain the reason why the Conference had been delayed. It is surprising how many telephone calls come into this office by readers who, having noted that a certain event has been planned and then find that it is not fructified, demand of this office why what we said was going to be, has not been! It is pleasing indeed to learn that something is being done, although not so pleasing to read that there is little evidence of any interest on a substantial scale from members concerned with organic finishing.

What is the Answer?

As has been stated repeatedly in this column, the idea is good; practical folk would like to have papers read on the user aspect of organic finishing materials, and yet although there is a demand the response to the Institute, according to the President, has been small. Surely the Council must ask themselves why? The demand exists; the Institute is wide enough in its appeal, and yet it has not attracted the folks they want. There must be an answer—and remember, the customer is always right. One need say no more.

Once more let it be emphasised that as far as INDUSTRIAL FINISHING is concerned it still persists in the belief that the regular publication of papers and regular discussions on all aspects of industrial finishing on similar lines to the manner in which the Institute treats electrodeposition, would serve a most useful purpose.

When a principle is involved the question of personalities becomes of secondary importance. Criticism does no harm, and indeed it can do much good. The Press has an important mission to fulfil because it is, or should be, quite impartial. Recently one saw an example of this in the modified television arrangements for the Coronation. The Press acted as the mouthpiece of public clamour that since millions of people would have no opportunity of seeing this royal event at first hand, they should be afforded as near to a sight of their Queen being crowned as the privileged few in the Abbey. It was Press clamour which caused an arbitrary autocratic decision to be amended. It was not the Press which expressed the opinions first—it was the members of the public.

And again, coming back to the question of the Institute, it is important to remember that the Press sits "off" the top table and away from the hierarchy, and mingles with the masses who pay their subscriptions. The Press rightly should ensure that comments and remarks made by these people should be ventilated. That is, surely, one of the fundamental aspects of a free Press.

The Institute can be assured that expressions of opinion perhaps in a critical vein are not conjured up by some vituperative personality pursuing the destructive cause of iconoclasm. The comments are merely a reverberation in print from those people who normally do not have an opportunity of expressing their viewpoint. It is difficult, for a junior member of an organisation to express his views in person if they are contrary to those of his boss. And it is quite a possibility that his boss might be wrong—or may be grinding a little axe all of his own. It is here that the Press can take a hand and ensure that the principles of democracy which are preached about so much in Britain are brought to fulfilment.

To the President of the Institute, thanks indeed for the kindly effort made to offer an explanation. In return it is felt sure that he will proffer thanks for the publication of his letter in full without any editorial amendment or omission. The editor comments upon this subect as follows:

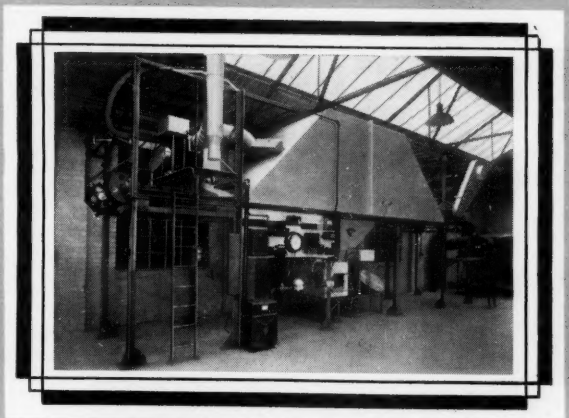
"I agree most definitely with the importance of the Press being free to express its opinions. . . . I have been approached by many members from time to time to allow my name to appear on a nomination form for various committees and councils of the various professional Associations of which I am a member. In all cases I have politely declined the offer for the simple reason that if one sits on the council of an Institution or professional Association one is, again, in accordance with the principles of democracy, faced with the necessity of accepting a majority decision or, alternatively, resigning. If one accepts that majority decision, the chair of Editor cannot be filled with strict impartiality, for the other viewpoint must be suppressed.

If one is going to be compelled to resign at the first controversial issue one might as well never have attempted to enter the portals of the door marked "officialdom." It is impossible to run with the hare and hunt with the hounds—an editor must not be cut off from the masses and their opinions and pumped full of the ideas, beliefs, hypotheses and in some cases manœuvrings of the hierarchy.

"That is why an editor must decline these high favours if he wishes to do his job well."

Paddle Wheel Fans.—We have received from Keith Blackman Ltd., Mill Mead Road, London, N.17, Publication No. 23, giving details of "Tornado" paddle wheel type fans. Containing 40 pages, this catalogue lists, illustrates and describes in detail "Tornado" standard belt-driven paddle wheel type fans ranging in size from Nos. 8 to 40. Copies can be obtained on request to the Publicity Department at the above address.

INDUSTRIAL OVENS



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DRYING ELECTROPLATED ARTICLES

Which Method?

by

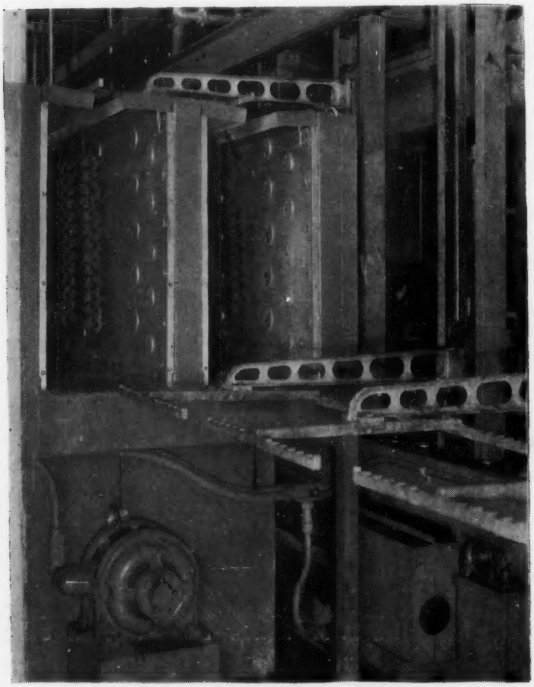
FRANK SPICER

THE rinsing and final drying off of electroplated components is, on the surface, a very simple matter, but in actual practice many problems present themselves to the plater. He will have to contend with shape, size, and quantity of the parts; it is obvious that a component possessing only a thin section will not dry as successfully as one with more "meat," the latter will, of course, retain heat much longer.

Many methods are used for the drying of plated goods, e.g., sawdust, centrifugal dryers, static ovens, compressed air, hot air, etc. In this short article the author will attempt to deal separately with them, giving his own opinion of the advantages and disadvantages offered by each.

Sawdust Drying

This is, of course, the oldest method of removing water from a plated or pickled surface, and is still in use in many shops today. In drying



Built-in hot air dryer on automatic plating machine

Courtesy: Hanson Van Winkle Munning.

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with sawdust, as in all other types, it is essential to remove every trace of plating solution by careful rinsing in cold water, followed by immersion in hot water maintained as near boiling point as possible, removing as much excess moisture as possible by shaking and then emptying into the sawdust pan. The sawdust pan itself is water-jacketed and heated. It is imperative that all components should remain in the hot water rinse until they have attained the temperature of the water bath, an excellent addition to the hot water rinse is a quantity of Calgon, which softens the water and thus makes any carbonates, etc., easier to remove: it also lessens the possibilities of staining. The normal method is to empty the parts into the sawdust pan and cover them with dust, moving them around until all faces have been exposed to sawdust; they are then transferred to the riddle and freed from sawdust by shaking.

An Improved Method

This is far from satisfactory, and the author has introduced what would appear to be a better method, that is the components are emptied into the sawdust in the normal way, except that beneath the surface of the sawdust is a plastic basket or tray. After covering the articles with sawdust, a lid is closed and the tray is vibrated by compressed air, operated by a foot-pedal. By further depressing the pedal the tray is lifted clear of the sawdust while still vibrating, the dust is allowed to settle, the lid opened and the parts removed.

The advantage of this is that by use of a plastic tray, scratching is lessened, and by vibrating under a closed lid, sawdust does not escape into the atmosphere of the shop contaminating solutions. It offers more comfortable working conditions to the operator. The choice of sawdust is important and boxwood is to be preferred; by all means avoid using any of the pine, larch or fir class, as they are liable to cause staining by the resins contained therein. A further deterrent to staining is to change the sawdust frequently, do not allow it to soak up too much effluent that may stray into contact with it.

The heat of the sawdust pan should be kept constant, which will coincide with that of the water in the jacket; if possible it should be thermostatically-controlled to just below boiling point. If allowed to reach boiling point, steam and ejected water make things unpleasant for the operator. A simple method for achieving this control was outlined by C. D. Leonard in *Electroplating*, September, 1950.

Hot sawdust may also be used in a drying barrel, which is heated by a row of gas jets playing on to the base of the barrel itself; this piece of equipment is popular where large quantities of small metal container tops are treated.

Centrifugal Dryers

Centrifugal drying of plated work has many advantages but it is also very limited. In this method the parts are placed, after normal rinsing, into a basket which is then placed in the machine, the lid is closed and a pedal is depressed, this pedal operates a clutch which causes the basket to rotate at a high speed while a current of warm air is drawn through the bottom of the basket, passing through the work. During the process excess liquid is thrown off by the centrifugal force, and hot air dries the work. The author does not recommend this method for drying work such as jewellery, watch cases, etc., where a high-quality finish is necessary, which must be absolutely scratch-free. But for the drying of barrel-plated articles such as screws, nuts and bolts, etc., it is ideal.

Static Ovens

Static ovens are quite useful for the drying of plated work, which can be hung inside while still on wires or suspenders, but where rack coatings are in use it can, of course, be detrimental.

Compressed Air

Compressed air is used for the removal of surplus water in many shops, but its success depends upon shape and gauge of the material being dried, and the ability of the part to absorb heat and to retain it. The author's experience of compressed air is that unless care is taken, and efficient removal of air and water is effected by a capable air transformer, staining will result. A lot of the

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condensate from air lines seems to find its way into the finishing shop.

Automatic Plating

On automatic plating machines advantage is taken to build in a suitable hot air dryer, as that shown in the illustration on page 328, and this is by far the most satisfactory method, the components are thoroughly dried without staining, and are not too hot to handle as they leave the exit end of the conveyor.

Finally we have the water displacing fluids, a comparatively recent development. These water repellant mixtures, mainly white spirit, were developed for the sheet metal industry, but are finding a use in the plating shop.

What happens is that as the article leaves the final hot rinse, it is immersed in a tank of water repellant, the surplus water falls to the bottom of the tank and leaves behind a surface uniformly coated with a white spirit solution. This coating, being exceptionally volatile, is easily dried leaving a surface free from stains.

A BARREL PLATING JIG

—*for Intermittent Use*

INTENDED for the type of shop where individual small loads of screws, nuts, washers, etc., have to be plated from time to time, rather than for bulk production, the automatic barrel plating jig offers the facilities of the normal type of horizontal or inclined barrel at a cost more in keeping with sporadic needs.

This automatic barrel plating jig is suspended from the cathode bar of an ordinary plating tank and can be treated in the same manner as a jig-load of articles. The equipment consists of two horizontal barrels of conventional design each having a capacity of two pints of screws, washers, nuts or small parts, suspended one above the other in a frame. The barrels are turned by a small electric motor which, with its driving gear, forms a complete unit attached to the frame. Current for the motor is supplied by a flexible lead connected to the nearest supply outlet. The motor is rated at 1/12 h.p. and the normal voltage 200-250 A.C. Special voltage motors can be supplied if necessary.

It is not necessary to apply the usual 12 volts to overcome barrel resistance as in normal practice. The automatic barrel plating jig will function quite satisfactorily at the voltages available on the cathode bar, viz., 6-8 volts, although plating will be somewhat slower.

The unladen weight of the jig is 18 lb. and can thus be handled without lifting tackle. The overall height is 24 in. and the width 16 in. Each barrel is 11 in. long, with a diameter of 4¼ in., and is constructed of aluminium and Holloplast, a laminated plastic of considerable resistance to all plating solutions and cleaners, the only exception being trichlorethylene vapour. The work contact points are provided by means of spring wires projecting radially into the barrel. They are readily replaceable, although less liable to build-up than stud contacts.

Being free rinsing, the loaded jig can be taken through an entire series of operations from cleaner to chrome vats, including the necessary swills without opening the barrel. The saving in time and labour represented by this ease of operation places this type of equipment in a very strong position, even taken against the greater output of normal type barrels.

Loading of the barrel is carried out by means of a removable panel forming one of its six sides, and is very easy. The whole of the jig is completely protected from acid contamination. For chromium plating an attachment is provided comprising four half-shells of lead fitting fairly close to the barrels and connected electrically to the anode bar and functioning as auxiliary anodes.

It will be appreciated that such a small unit has many possibilities, not the least of which is the use of a battery of the jigs used in an ordinary plating tank and forming a complete barrel plating unit. It is considered that such a unit could comprise eight two-barrel jigs in one tank, fourteen barrels plating, whilst two are being unloaded and loaded and would provide sufficient work for one operator. By this means a very flexible unit would be available, where the work consisted of small batches in wide variety. By means of this jig it is also possible to barrel plate small parts in hot solutions such as stannate tin and bright nickel.

It would appear that any vat capable of plating wired or jigged articles can be used with this equipment for successful barrel plating, saving shop space and capital outlay.

The makers are John Preston and Co. Ltd., Stanley Road, South Acton, London, W.3 (Telephone: ACOrn 0367), who will also undertake servicing, including a reconditioning service for the electric motors, which can be handled from stock.

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Automatic Barrel Plating Jig

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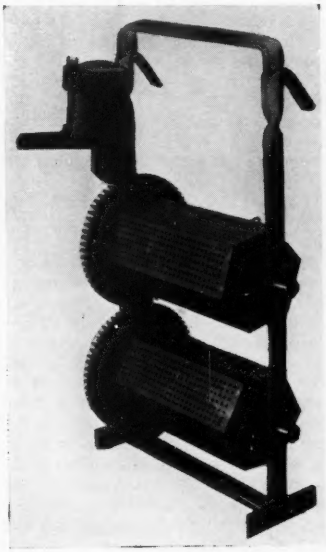
Overall Width	... ...	**16"**
Length of Barrels	... ...	**11"**
Diameter of Barrels	...	**4¼"**

Capacity per Barrel :
2 Pints—Screws, Nuts or Small Parts.



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ALUMINIUM PAINTS

by

R. H. WARRING

ALUMINIUM paints or, more truly, aluminium pigments, possess many unique properties as coating materials. It is true to say, for example, that no other simple paint has as great a resistance to deterioration, coat for coat, and few other coatings have as high a reflectivity or as low an emissivity, where thermal insulation properties are concerned.

Aluminium paint can be a most effective primer, followed by a further coat of aluminium or some other type of coating where maximum protection is required; as a combined primer and finishing coat where a single paint application is desirable (possibly on economic grounds); or mixed with other paints for use either as a primer or finishing coat, or again as a one-coat system. Much exterior industrial plant and metalwork is finished with a protective coat of aluminium paint. Aluminium paint is also equally effective on wood surfaces. Possibly this is not so widespread in this country, but in America it is common to find wood farm buildings, fences, wooden bridges, scaffolding, etc., finished in aluminium paint on account of the maximum protection afforded at minimum costs. This even applies to roofing where an aluminium coating has been found to reflect roughly 75 per cent. of the sun's energy, promoting cool interiors and lengthening the life of the roof covering.

A Unique Property

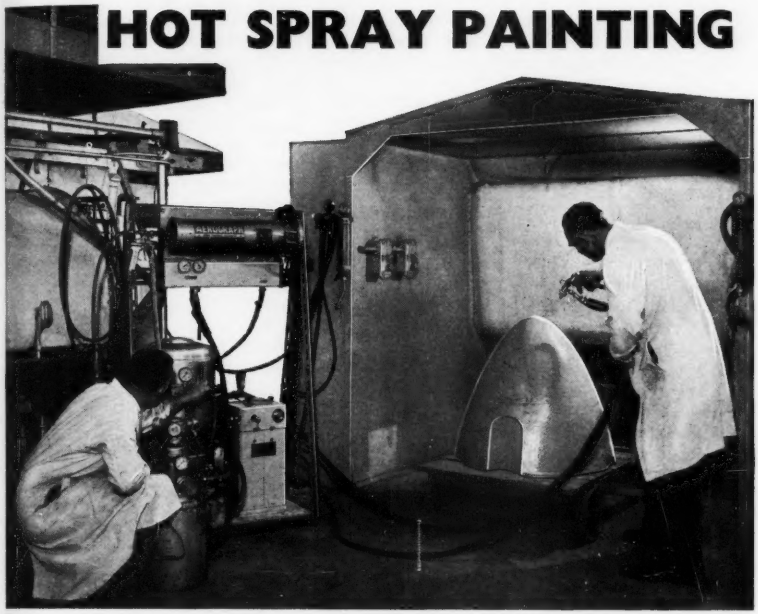
The value of properly compounded aluminium paint lies in the fact that the individual particles of aluminium which form the pigment possess the unique property of *leafing* when the paint vehicle dries out. To understand this it is necessary to appreciate the form in which the aluminium pigment is used. The pigment or solid content of the paint actually consists of minute flakes of pure aluminium—referred to as aluminium powder but physically flat in form rather than spheroid. The shortest dimension of a flake (width or length) is generally several hundred times as great as the thickness of the flake. At the same time the flake itself may be small enough to pass through a mesh having up to 300 wires or divisions per inch. Actually aluminium powders for pigments are available in a variety of sizes, determined by the size of mesh through which the powder of flakes will pass. Various grades or sizes are used for specific coatings. The very finest powders of all are usually supplied in paste form, consisting of not less than about 60-65 per cent. of aluminium powder mixed with a suitable binder. If these fine powders were not rendered in paste form they would be extremely difficult to handle, very fine metal powders having the property of "flowing" like a liquid and being readily disturbed by the slightest air currents.

Leafing Procedure

So much for the physical shape of the individual aluminium particles used in aluminium paints and coatings. They are actually produced by a hammering or stamping operation in which a special lubricant is used. This lubricant remains as a thin coating on the individual flakes so that the surface of each flake is not readily "wetted" by the normal paint vehicles used. Thus the aluminium flakes tend to float on the surface of the paint vehicle, succeeding layers arranging themselves parallel to the surface, and so on, so that the effect is similar to the "carpet" formed by falling leaves, each individual leaf overlapping its neighbours.

The resulting aluminium paint form, therefore, consists of layer upon layer of aluminium flakes, with only a thin

HOT SPRAY PAINTING



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The photograph shows a corner of the Demonstration Centre with operators hot-spraying synthetic enamels at the water-washed spray-booth. Three types of paint heaters are shown in the illustration. Take advantage of this "know-how" and let us help you to *control* your finish.

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layer of paint vehicle covering the top layer and lying between adjacent layers. The paint vehicle binds the individual flakes together and protects the film against expansion and contraction under the effects of heat and cold. The covering itself is virtually one of pure metallic aluminium.

Excellent Sealing Properties

Providing the paint is properly compounded this covering has considerable hiding powers and also remarkable resistance to moisture and weathering. Moisture cannot pass directly through the individual metallic flakes. Its only path is around the edges of these flakes, backwards and forwards through the many layers forming the complete coating. Thus the resistance offered is many times that which would be afforded by another type of paint with the same paint vehicle. In other words, aluminium paints provide excellent sealing properties. One coat is usually sufficient to seal any surface. One coat, too, is generally opaque enough to cover completely any underlying colour, even black.

On woodwork the good sealing properties of an aluminium paint also works in another way. Besides preventing the ingress of moisture it also prevents, or at least greatly reduces, any change in the water content of the underlying material. It is just as difficult for moisture to escape *out* through the paint coating as in. Hence the life of the woodwork is further enhanced and tendencies to split or warp reduced. The aluminium coating is an effective seal, once properly applied.

The aluminium coating itself is also strongly corrosion-resistant. On exposure, a thin film of oxide forms almost immediately on metallic aluminium. this has to be fully transparent, but thick enough in the physical sense to resist all normal corrosive action.

Aluminium oxide is an inert, extremely hard substance which is not readily attacked.

This inertness of aluminium paint particles is of particular value when used as a covering for metal surfaces. Ferrous metal articles normally subjected to rapid oxidation under weathering, perhaps accelerated by high temperatures, as in flues, stacks, vents, etc., are usually adequately protected by a single coat of aluminium. Even if the operating temperature may be high enough to damage or burn out the paint vehicle, the aluminium particles will remain unchanged, and in situ, unless physically disturbed. In such cases, however, it is usual to employ heat-resistant paint vehicles, such as silicones, which remain stable and unchanged at elevated temperatures when prolonged protection may be realised under the most adverse conditions.

The secret of a good aluminium paint lies first in the use of the right type and size of aluminium powder for the job and then the selection of the proper vehicle, the two being compounded in the correct proportions. Again aluminium shows a considerable economy over most ordinary paints. Most aluminium paints average less than 2 lb. of aluminium pigment per gallon of paint, whereas lead paint, by comparison, usually averages 25 lb. of pigment or more per gallon of paint.

Paint Vehicles

The subject of paint vehicles for use with aluminium pigments is a vast one. Broadly speaking four different types of vehicles are used—varnishes, lacquers, bitumens or silicones. The latter are still relatively new and largely unknown. Varnishes are most widely used for general purposes. Lacquers are employed as vehicles where quick drying and attractive finish is essential. Bituminous vehicles are used for special types of aluminium paints developed specifically for roof coverings.

In the case of varnish paint vehicles, these may be of the oil base, resin base, or oil-resin base types. It is general, in referring to their characteristics, to specify the "oil length" of the particular vehicle. Oil length is simply the proportion of oil to resin in a varnish in terms of gallons of oil per 100 lb. of resin. Thus a 12½ gallon oil length varnish consists of 12½ gallons of oil per 100 lb. of resin in an oil-resin base vehicle.

Optimum oil length of the paint vehicle depends very largely on the

ALUMINIUM POWDERS

Type	*Particular size*	*Manufacture*	*Application*	
Granulated	up to ⅛" dia.	Atomising (general)	Industrial	
Grained	$\frac{1}{64}$"-¼" long	Stirring molten aluminium	Industrial	
Flake	40-300 mesh	Stamping	Industrial	
	80-900 mesh	Ball milling	Coarse Fine Paste	Pigments

purpose for which the paint is being prepared. For woodwork, where toughness, flexibility and maximum water resistance may be the main aim a very long oil length is generally used. In other words the paint vehicle consists mainly of oils and dryers, plus a certain proportion of volatile thinners. For heat-resistant aluminium paints the vehicle may be of zero oil length, i.e., no oil, the base consisting of a resin dissolved in a suitable solvent.

The addition of a volatile solvent is necessary to promote good leafing. In general, other factors being equal, a vehicle promoting good leafing has a low viscosity, a high specific gravity (above 0·85) and a high surface tension (above 27 dyne/cm.). All of these factors affect the original leafing. Retention of this leafing is dependent on the vehicle having a low acid value and a low processing temperature. Thinners which have a too rapid evaporation will not let leafing develop fully with consequent poor appearance. A film with good leafing properties has a bright, metallic surface when dry and should retain this appearance and general physical characteristics for periods of up to two years. A film which has not leafed properly has a dull, streaky, leaden appearance. The fault in such cases generally lies with the paint vehicle.

A laboratory method of testing for leafing ability is as follows. In the bottom of a 100 c.c. beaker is placed 7·5 grm. of aluminium pigment (powder or paste), to which is added 42 c.c. of the paint vehicle. When the pigment has completely dispersed through the vehicle the beaker is emptied with a rotary tipping motion so that the whole of the inside surface is wetted with the paint. The empty beaker is then held inverted for 20 sec. and then allowed to stand at rest in a draught-free room or cabinet at an air temperature of approximately 70°. After a period of about 30 min. all leafing will have ceased when the distance from the inside of the bottom of the beaker to the leafed portion is measured. This dimension (in millimetres) is a criterion of the leafing qualities of that particular paint mix.* It is a further requirement of all good aluminium paints that excellent leafing properties should be maintained for a period of two years under storage conditions.

The performance of an aluminium paint (or any other type of paint for that matter) can also be expressed by a number of other physical criteria. One of the most important of these is the Kauri reduction test applied to varnish vehicles. This is used to determine the toughness and flexibility

* *This test method is used by the Reynolds Metal Company, U.S.A.*

PAINT VEHICLE PROPERTIES

Vehicle	*Good Leafing*	*Poor Leafing*
Viscosity	Low (A-C Gardner Holdt Scale)	High
Specific gravity	High (above 0·85)	Low (below 0·85)
Oil length	Various	
Surface tension	High (above 27 dyne/cm.)	Low (below 27 dyne/cm.)
Temperature	Low	High (above 550° F.)
Surface moisture	Low*	High*
Agitation	Gentle stirring	Excessive agitation
Thinners	Slow-medium drying	Rapid drying

* Affects leafing indirectly. Most effect on stability of film.

of the film produced by any paint vehicle.

In this test a number of standard panels are prepared by coating with the paint vehicle. On each succeeding panel the elasticity of the basic paint vehicle is reduced by the addition of a standard solution of Run Kauri gum in pure spirits of turpentine, allowing each film ample time to dry. The test panels are then bent over a standard form to determine at which stage of reduction the film cracks. Reduction of the original vehicle is by 10 per cent. stages, and so the test figure resulting gives the range of reduction during which cracking occurs. For example, a Kauri reduction of 90-100 means that the film, on test, does not crack at 90 per cent. reduction but does crack at 100.

Measurement of Leafing Properties

Other tests commonly employed by paint manufacturers are based on actual measurement of the leafing properties of the pigment in standard vehicles (as opposed to tests on the leafing properties of the paint vehicle), tests on colour, opacity, weathering, and so on. Not all pigments have the same leafing properties, in fact aluminium powders can be produced which have definite non-leafing properties. These are used, often mixed with a leafing pigment, to produce polychromatic finishes where the flakes dry with random orientation within the body of the paint film. Generally such paints are prepared with a coloured pigment as well to produce "pearlescent" colours of various metallic tones. More recently aluminium paint with controlled leafing properties has been prepared as an admixture with other paints to combine the desirable protective features of aluminium paint with the non-metallic surface of a normal colour paint. Opinion is often sharply divided as to the æsthetic value of large areas of aluminium paint as contrasted with "normal" paint surfaces. There is little doubt that good aluminium paint provides better protection at lower cost than most normal paints. The main idea behind the admixture is to combine the virtues of the two.

Aluminium roof coatings are of a special kind. In this case vehicles are of a bituminous nature, compounded of asphalt, tar or pitch base with a volatile solvent, and frequently the addition of resins, fibres or drying oils. The solvents used generally have a high specific gravity to promote leafing when a brilliant metallic top surface results. High leafing power is required both to hide the colour of the dark vehicle and the dark surface over which roofing paint is usually applied. Bituminous base aluminium roof coatings are often formulated so as not to dry to a hard film, hence overbrushing must be avoided otherwise the partially set surface may be disturbed and dark streaks result.

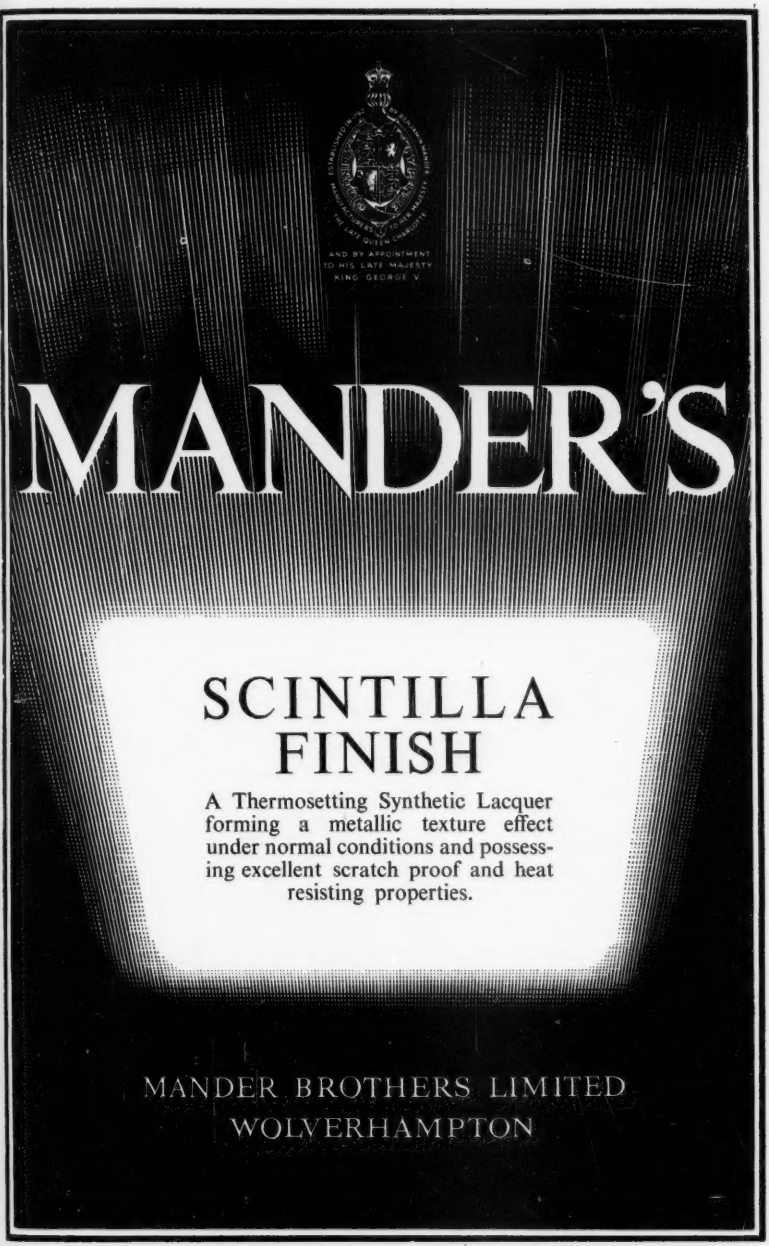
Roof Coating Test

With its high reflective power (roughly 75 per cent.) an aluminium paint used as a roof coating can produce quite remarkable interior cooling. In a typical test on an asphalt-covered roof an interlayer temperature of 150° F. was recorded with a shade temperature of 95° F. With the same shade temperature and the same roof covered with a coat of bituminous aluminium paint, interlayer temperature dropped to around 110° F.—a heat reduction of 40° which had a most marked effect on the interior temperature of the building. Conversely, the low emissivity of aluminium produces a "heat storage" effect when the interior temperature is higher than that of the external temperature.

The emissivity of aluminium is around 30 per cent. at 100° F., as compared with a black body showing perfect emissivity (100 per cent.) at the same temperature.

High Vacuum Method

Within the past two or three years the use of aluminium as a covering material applied *without* a paint vehicle has also come into prominence —the method being one of evaporating aluminium in a high vacuum chamber to condense as a surface coating a few microns thick on objects within the chamber. As yet applicable only to relatively small articles, aluminium coating by high vacuum has opened up many new possibilities in the use of this ubiquitous metal. Aluminium paints, in the meantime, continue to improve in usefulness and durability.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ROLLER COATING

by

H. J. TESTRO

IN the industrial finishing field, it is axiomatic that the majority of organic finishes are applied by either hand or automatic spray methods using compressed air as the paint propelling force. However, of the other application methods not embracing atomisation principles, the two most widely utilised are dipping and roller coating. The latter method forms the subject of this article which will broadly consider the equipment involved, the scope, application and merits of the process.

Roller coating is a highly efficient method of applying organic finishes to suitable work of large surface area relative to thickness. The process is similar in some important respects to printing in that the coating material is transferred from the periphery of a revolving cylindrical roller by direct contact. The fundamental difference is that, in this case, orthodox coating materials, e.g., paint, varnish or lacquer are applied. Within the strict meaning of the term the process may involve hand or machine operation.

Equipment—Manual

In its ultra simplest form the application of the coating material is by means of a small roller manually operated. In practice, a small quantity of the coating material is initially poured on a plate glass slab, or, into a shallow vessel of adequate length and breadth to accommodate the roller. The action of passing the roller backwards and forwards through the liquid surface ensures that the coating material is uniformly distributed over the entire surface periphery of the roller. The coating material is subsequently transferred to the worksurface by the simple expedient of rotating the coated roller over the entire area.

In common with the majority of manual finishing methods, hand roller coating is necessarily slow in operation and, to some extent, uncertain in results. The difficulties are twofold—to uniformly coat the roller with the precise amount of material and to maintain a positive even pressure in application. It is only with the high speed mechanical methods of roller coating that the full merits of the process in respect of exceptional speed of application coupled with optimum material economy can be realised.

Roller Coating Machine

As differentiated from hand operation, roller coating machines utilise a series of composition and metal rollers. The simple types of automatic machines (often adaptations of glue spreading machines) made for coating one side of flat stock consist essentially of a train of three horizontal rollers in opposite rotation. The fountain, intermediate or feed, coating or impression rollers as they are variously known are in constant moving contact. A feed table with suitable edge guide rails may be provided at the loading side of the machine and a roller delivery table at the take-off side. Alternatively the work may be progressed through the machine by means of a horizontal endless mattress type conveyor. On thin gauge work the introduction of a knife scraper on an underneath driving roller serves the purpose of preventing the coating material being smeared on the underside of the work.

The fully automatic high speed machines are more detailed in construction and are built to high engineering standards. According to type they can coat simultaneously both sides and even the edges of work of appreciable thickness. The latter feat is accomplished by means of

vertical edge rollers located behind the main rollers; these rollers may either be gear-driven or rotated by the thrust of the oncoming work. Fountain, feed and impression rollers are adjustable and, by means of a micrometer adjustment, a predetermined film thickness can be deposited and the setting recorded for future reference. A trip lever enables the feed roller assembly to be thrown out of contact with the impression roller during stand-by periods and subsequently returned to the original setting. Provision is often made for water cooling the impression roller by means of internal coring.

A feature common to most types of fully automatic machines is that automatic infeed and offbearing is provided. Also, on some machines an automatic pile lifting attachment ensures that the top sheet of the workpile awaiting processing is always at the correct level for feeding into the rollers. Suction pad arrangements are often used to pick up the sheeting for feeding into the rollers.

Rollers

Irrespective of the method of application, the requirements of the actual coating roller are that it should be smooth faced, resilient, and capable of some resistance to deformation in diameter to accommodate any slight inconsistency in the thickness of the work—the resilience enables thin gauge work to be coated on the edges. Holding equal importance is the ability to withstand attack by the solvents both initially present in the coating material and subsequently employed for cleaning down operations. Also, it is manifestly obvious that the roller composition must be receptive to the coating material in order that a coherent film may be formed In compliance with the aforementioned requirements the choice usually falls upon gelatin compositions and natural or synthetic (Neoprene) rubber.

Methods of Coating Material Feed

Various methods of material feed are adopted. One system is the gravity drip method in which the coating material is retained in a suitable size container overhead to the rollers; the container is provided with an outlet cock at the bottom and an adjustment to provide the required rate of material deposition to the rollers and, may be arranged to travel laterally to provide equalised distribution of the coating material. In a variant of this method of feed, the coating material is retained in a Vee vertical section hopper mounted overhead and in close proximity to the rollers; again, a suitable metering device for material fed is provided. Alternatively, the coating material may be contained in the reservoir provided by the angular space between the roller and retained by means of specially designed end plates. Further, in the case of an underneath impression roller for coating the underside only of the work, the coating material may be contained in a trough, the first roller in the series skimming through the surface of the liquid.

Other methods of coating material supply include pressure feed delivery on to the rollers through rubber or metal pipe lines from a separate material container.

Operation

In operation, work for processing is carried through the rollers by friction. It is evident that, at this stage, the worksurface must be physically clean to ensure complete wetting, together with uniform distribution and specific adhesion of the coating material at the work/coating material interface. On large volume production the entire process is continuous and used in conjunction with conveyorised feed to link up with the preliminary and subsequent processes of metal cleaning and stoving respectively.

Stoving

Roller coating finishes of the heat transformable type will stove by both infra-red and convection means and offer the usual advantages associated with this type of finish. Specialised rapid heat transfer through convection type ovens have also been designed for the tin printing industry and may be singled out for special mention.

In this type of oven, which utilises circulating air at high velocity, the sheets are carried through in a

special type of open work wicket carrier (familiarly known as a "toast rack"). By precise timing the carrier is automatically in a horizontal position to receive the sheet emerging from the roller coating machine. A noteworthy feature is that the pitch on the spring tensioned conveyor may be as low as 1 in. to permit a dense load factor of twelve sheets per forward foot.

Provision is normally made for some form of air circulation at the last stage of the oven to ensure that the work emerging at the unloading end can be safely removed and stacked without incurring damage to the finish. The oven temperature, thermostatically controlled, is determined in the first instance by the interrelated factors of the curing temperature of the finish and the speed of forward travel which is, in turn, related to the speed of the roller coating machine. The degree of synchronisation effected enables the whole unit to operate at maximum capacity.

Notes on Formulation

Whilst most conventional types of film forming organic coating materials are adaptable to the roller coating process, the success of the machine operation is usually dependent on specialised formulation. Roller coating formulations have to comply to several essential requirements and, in outline, the following principles of importance are illustrative.

High opacity is demanded in the case of coloured finishes insofar as, judged on a comparative basis with brushed or sprayed finishes, it is substantially true to state that a somewhat thinner coating is applied. This factor demands small particle size pigments of high obliterative power together with a high standard of grinding. Further, an important requirement, dictated by the degree of pressure involved, is that soft or relatively non-abrasive pigments be selected to avoid undue wear on the rollers during long runs.

Good flow coupled with reasonably slow initial set is required in that, apart from the ability to ensure even distribution, the coating material must obviously retain its fluidity during passage over the rollers, certainly without "gelling" tendencies. Low surface tension is a feature of parallel importance to ensure uniform wetting of the rollers to obviate a ribbed or "striated" effect on the work; wetting agents are often incorporated in the formulation. Freedom from "frothing" conducive to voids in the applied film is also an important requirement.

Surface tension (defined as the cohesive force in fluids) is greatly influenced by the selection of solvents. The effect of the roller coating process is to increase the vaporising tendencies of the solvents and this feature must be suitably offset. Of no less consequence is that the solvents must not have any appreciable attack on the composition of the rollers. The question of solvents is furthermore important inasmuch as, apart from technical considerations, operatives usually express a strong preference for mild solvents, e.g., white spirit, for cleaning purposes.

Notwithstanding the employment of polished, plated or greased die tools, a high degree of resistance to local shock is of paramount importance for finishes intended for subsequent stamping, forming or shearing operations. Brittleness on shearing as the result of technical shortcomings in respect of adhesion and elasticity defeats the whole object of the process. Long oil alkyd stoving finishes often incorporate small percentages of "slip" agents such as pine oil, petroleum jelly or wax which are, in small measure, of value as die lubricants.

Other requirements are dictated by the end use of the product. Finishes for food canning purposes must obviously be free from toxic properties and have effective resistance to fruit acids, etc. For multi-coat work it is important that the medium must be able to withstand successive stovings without detrimental effects as regards embrittlement, discoloration and loss of adhesion.

Viscosity

The viscosity of the coating material is a property which exerts great influence on application characteristics and end results. This value is usually somewhat higher *vis-à-vis*

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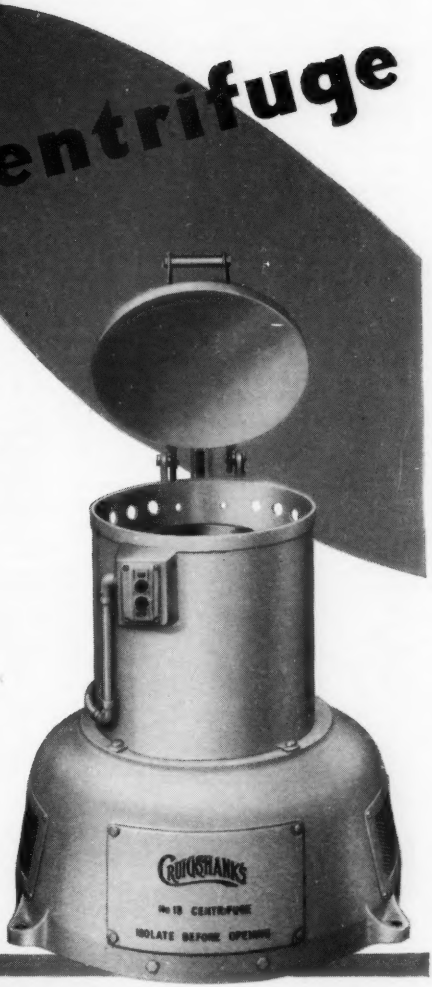

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normal spraying operations. The control of viscosity forms an important part of the technique and must be correlated to the related factors of the condition and absorptive nature of the worksurface, the speed of movement between the rollers and the pressure applied. Pronounced sub-superficial porosity and differences in absorption characteristics of the worksurface may dictate an increase in viscosity coupled with a lower roller speed to ensure a solid coating. Stability of atmospheric temperature and relative humidity to suitable values is often essential to ensure concordant results.

Application of the Process

The roller coating process is not applicable to products highly diversified as to shape and size and, in common with automatic methods of finishing, is relatively inflexible in operation. The principal application of the process is to plane, uniform, rigid or semi-rigid surfaces such as flat sheetings which require to be coated over the entire surface area. There are, however, certain notable variants of the main process, namely, the coating of round and raised surfaces and the reproduction of special and decorative effects.

The outstanding example of the successful application of the roller coating process is provided by the tin box, metal container and allied metal decorative trades. In this respect the method is not restricted to thin gauge metals as, by a patent process, 18 gauge steel sheeting for the manufacture of 40-gal. drums has also been processed in this manner on a mass production basis. The process is also applicable to the organic coating of plywoods and hardboards for specific purposes. As previously inferred, the roller coating practice is well established in other manufacturing industries in which it is both convenient and practical to coat entire sheets prior to stamping, forming, fabrication and/or thread rolling. Decorative metal bottle caps, children's paint boxes and toys are illustrative in this respect.

Moreover, the process is not confined to single application and single colour work. Decorative rotary press lithographing with special "inks" may be loosely included under the heading of roller coating. This process, which provides very accurate register of colour, requires the requisite number of presses and applications. Usually, a final roller coated protective clear finish is applied.

As indicated, the roller coating process is furthermore not limited to the processing of flat sheets. Adaptations of the method include highly ingenious machines specially designed to coat round surfaces such as tooth paste containers. Decorative applications in this field range from the striping of small articles such as lipstick holders and torch cases to providing a contrasting band of colour around large steel drums. In the first named applications a serrated steel roller or a synthetic rubber roller with annular channels is utilised, either running in a bath or backed by a feed roller.

Another variant of the basic process concerns the coating of upraised letters and figures on road traffic and other signs in a colour contrasting to that of the background. Imitative wood graining is produced from a master copper roller bearing an exact facsimile of the wood grain. The master roller, which contacts the impression roller, is produced by a specialised technique, and is often chromium-plated to provide a greater measure of surface hardness to increase service life. Graining processes are normally a three coat application, the sequence of operations being, ground coat, graining colour and clear finish. Although seldom practised, the roller coating process is also adaptable to the reproduction of marbling effects, the sequence being identical to that of the graining process.

Summary of Economical Advantages

In conclusion, the economical advantages of the roller coating process can conveniently be summarised under the following main headings.

(i) Exceptional speed of application ensuring a high rate of throughput. Coating speeds can be higher than for other application methods and, in this connection, up to 3,000 coated sheets per hour are possible. Indeed, the limitation on processing speed

may be imposed by the amount of free floor space available in terms of adequate storage facilities for air-drying or, length of oven necessary for stoving.

(ii) A substantial contribution towards reduced labour costs, in that, once the machine is set up, relatively unskilled labour can be employed in the capacity of machine minder.

(iii) High quality of finish with uniform film thickness ensuring consistency of results.

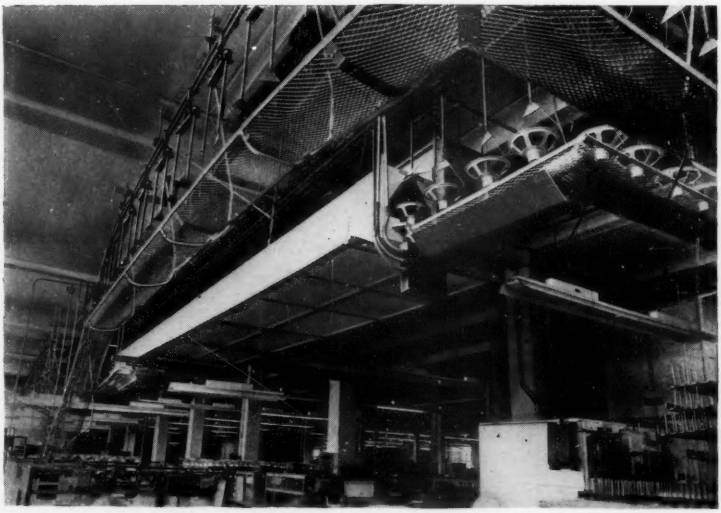
(iv) A high material utilisation factor is that (a) the percentage of solvent merely to facilitate application tends to be reduced, (b) coverage per square foot per gallon is high, and (c) no loss by overspray or drag-out is incurred.

Wastage is virtually confined to that involved in washing down the machine plus inevitable spillage from containers.

PAINT STOVING LOUDSPEAKER ASSEMBLIES

THIS installation by T. C. Spray Finishing Systems, incorporates a Metrovick infra-red oven suspended from the ceiling above the work benches for stoving paint on loudspeaker assemblies at Plessey Ltd. The assemblies which vary from 5-10 in. in dia. are conveyed through the 48-ft. long oven at a speed of 10 ft. per min. on special hangers.

The source of infra-red energy in this installation is provided by special Metrovick electric infra-red projectors fitted with tubular-sheathed elements which operate at red heat. These elements consist of a spiral of high-grade heat-resisting wire tightly embedded by a special process in a mineral insulator, enclosed solidly in an outer sheath of $\frac{5}{16}$ in. tube of a non-scaling non-corrodible alloy. The process ensures not only that the spiral is held immovable in the centre of the bore but also that an even thickness of insulation separates it from the sheath. The projectors themselves consist of trough reflectors in a robust frame designed for maximum strength consistent with light weight. The reflectors are constructed from high-grade aluminium sheet which has been subjected to a special anodising process to give maximum heat reflection and to protect it from atmospheric corrosion. Standard projectors of a similar type are available which form clean and efficient units adaptable to almost any production line, enabling an intense energy concentration to be obtained where and when required.



Metrovick infra-red oven paint stoving loudspeaker assemblies

THE PORTABLE *p*H METER

An Aid in Plating Thickness Determination

by

G. HOWELLS, B.Sc.

THE importance of a *p*H meter in a plating shop is already universally recognised. Plating solutions have to be adjusted so that their *p*H values are within fairly close limits and "rule of thumb" methods are rarely successful.

However, this article is mainly concerned with the measurement of plating thickness, and the ways in which a *p*H meter can be used in modifications of some of the standard methods. Any laboratory type of *p*H meter can be used, but a portable, direct reading type such as the Marconi Instruments model T.F. 889, pictured above, is much more convenient to use.

In the methods to be described, the *p*H meter is primarily used as a high resistance input millivoltmeter. The scale reading can be readily converted into millivolts if desired, but this is not often necessary, as only an indication of change of voltage is required.

B.N.F. Jet Test

This test was devised for the British Non-Ferrous Metals Research Association by S. G. Clarke[1] and has become one of the standard methods for the measurement of thickness of many electroplated models. A jet of appropriate solution is caused to impinge on the surface of the test sample at the selected point, and the time for penetration is taken as an indication of the plating thickness, calibration curves being available. The penetration point is normally determined by stopping the jet periodically and carrying out a visual examination of the surface.

The advantages of the test over the method in which samples cut from a product are weighed, stripped of their plating and re-weighed, are several, among the chief being that the basis metal is unaffected (and so can be stripped and replated, if necessary) and that the thickness at any particular spot, and not the average over an area, is measured. An accuracy of 15 per cent. is usually claimed.

The disadvantages are (a) the periodic stoppage of the jet to examine the surface in order to detect the end point; (b) that the end point in some cases is very difficult to determine—particularly when composite coatings are being examined.

These difficulties may be overcome by using the difference in electrochemical potential of the plated and basis metals, when in contact with the test solution, to indicate the penetration point. A reference cell, such as a saturated calomel electrode, is immersed in the reservoir and leads from this and from the plated article are taken to a voltmeter of high input resistance—in other words, to the *p*H

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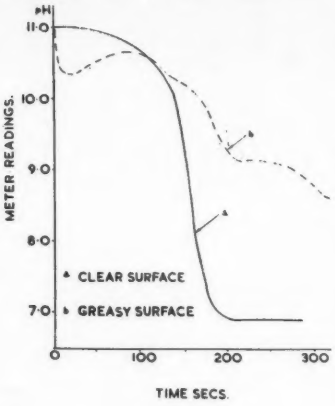

Fig. 1

meter. When penetration occurs, the reading will alter because the cell in circuit then consists of the basis metal —liquid—calomel cell. This change in voltage is usually sharp and so the measurement of the time taken to penetrate the plating can be quite accurate.

When porous coatings are under test, the change in voltage is slower; thus it can be seen that the method provides an indication of the quality of the plating as well as its thickness. It is necessary to decide which point on the curve represents the true end point, and this is done by carrying out a number of comparison tests on sample pieces using the chemical stripping method.

In Fig. 1 curve (a) shows the type of change which occurs with a clean sample, while curve (b) is typical of the result obtained on a surface which has not been properly degreased.

Francis Thickness Test

This method[2] was in the first place intended for the measurement of the thickness of electrolytic and hot-dipped tin coatings but can be used for many other metals. Here again, use is made of the change in the electro-chemical potential at the surface when the coating is removed, but plating in this case is removed electrolytically by making it anodic in a special cell. The process is a slower one than the Jet Test and is most suitable for the platings less than 0·0004 in. in thickness.

A cell arrangement which has been found to work satisfactorily is shown in Fig. 2. The tube is made of stainless steel and this is caused to press on to a rubber gasket which insulates it from the test plate. The tube is half filled with electrolyte and the current is supplied by a battery controlled by means of a variable resistance and measured by a meter. The efficiency of the stripping process is not in itself important, but it must be kept constant to ensure consistent results. The best way to do this is to keep the current small—about 1-2 mA.

The potential across the cell is made up of two parts: (a) the potential drop due to its ohmic resistance and the current flowing, and (b) the electro-chemical potential across the cell, which depends on the particular solution used and on the nature of the plating under test. The voltage is reduced by a potentiometer and monitored by means of the *p*H meter, the reduction ratio being adjusted so that the whole range comes within the scale length of the *p*H meter.

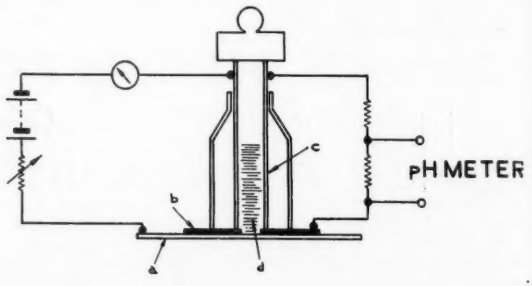

Fig. 2

Absolute values of potential are not needed as only the time involved is required for the calculation of plating thickness.

The changes in potential across the cell during the stripping process are indicated in Fig. 3. The ordinates are given in *p*H units; thus the sensitivity of the meter indication can be estimated, the full scale length being 4½ in. for 1-11 *p*H and the voltage dividing ratio used for the measurement being 1:4.

The voltage change in the first minute or so is probably due to an oxide layer on the surface, while the second change is due to the removal of the final layer of plating; the

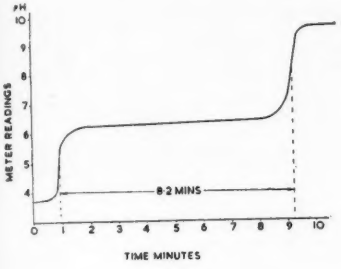

Fig. 3

stripping time being taken between the two middle points, as shown in the diagram. The curve was produced from readings taken every 5 sec.; in practice, once a number of measurements have been made and a standardised procedure adopted, the "middle points" will be known in *p*H units and so a stopwatch operated as the meter point passes them is all that is required.

The current is supplied from a high-tension battery of such a value that the changes in voltage across the cell are small in comparison and so have negligible effect on the current flowing.

It has been found necessary to degrease the test plate thoroughly with an organic solvent and then submit it to cathodic action for about 2 min. before beginning the stripping process in order to obtain consistent results. A reversing switch is useful for the purpose.

The method is usually used for tin coatings on steel. In the case of hot-dipped, or flow-melted electrolytic tin coatings, the layer of alloy formed at the surface of the basis metal is not dissolved and this method, in conjunction with Clark's method, is sometimes used as a means of measuring the degree of alloying which has taken place. Other combinations can similarly be measured. An electrolyte consisting of 10 per cent. caustic soda is satisfactory for tin, zinc and chromium platings, while 10 per cent. sodium cyanide is used for cadmium, copper, silver and gold. No electrolyte has been found to give good results with nickel.

Care must be taken that the same concentration of electrolyte is used for each operation in order to obtain reproducible results. For instance, it has been found that a decrease of 20 per cent. in the concentration of caustic soda brings about an increase of about 10 per cent. in the time required to remove the plating.

References

1. S. G. Clarke. *J. Electrodep. Tech. Soc.*, **12**, 1936, p. 1157.
2. H. T. Francis, *Trans. Electrochem. Soc.* **93**, 1948, pp. 78-83.

GRIFFITHS BROS. MANCHESTER OFFICE

ON 2nd December a short ceremony took place at Armour House, 28 Hyde Road, Ardwick, Manchester 12, where Griffiths Bros. and Co. (London) Ltd., the well-known paint and insulating varnish manufacturing firm, opened their Manchester branch office and depot premises.

Consumers of Griffiths Bros.' products in Manchester and surrounding districts were invited to this ceremony, which comprised the official opening of the premises by the company's governing director, Mr. K. L. Thornbery, a tour of inspection of the depot at the rear of the office premises, and an informal luncheon at the Café Royal.

It is hoped that better delivery and technical service will be derived from the provision of the premises, where full facilities are afforded for interested users to meet at their showroom for advice and assistance.

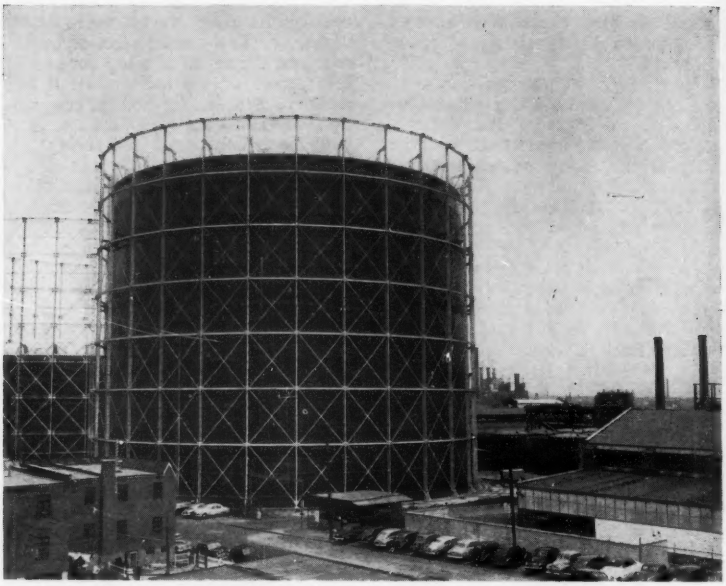

Fig. 1. Flotation method painted this gas holder at the rate of 69,000 sq. ft. an hour

PAINTING BY FLOTATION METHOD

EIGHT years ago, the Consolidated Edison Co. of New York, Inc., began experimenting with a new method of painting the large submersible surfaces of its many water-sealed gas holders. These water-sealed holders, familiar objects on the skyline of every sizable community, operate much like the old-fashioned collapsible drinking cup. As gas is pumped in or out of a holder, its various sections or lifts are alternately submerged in water and exposed to the atmosphere. Consequently they are particularly susceptible to corrosive influences. Consolidated Edison sought a painting method which would be more corrosion-resistant than conventional methods.

What Consolidated Edison calls the "flotation" method was the result. The company's painting engineers sought, and successfully developed, a protective film of drying paint which could be floated on the sealing water and which would adhere to a descending lift surface as it passed through its submersing cycle. As a lift descends through the film of paint and into the water, positive hydraulic pressure forces the paint into the lift surface and distributes it uniformly. As the lift rises, surplus paint flows off, to float again on the water seal where it can be pumped off for re-use.

Before trying the new method on the vast expanse of a gas holder, a

This article, by L. B. Donovan, Consolidated Edison Co., of America is published by courtesy of the "American Paint Journal."

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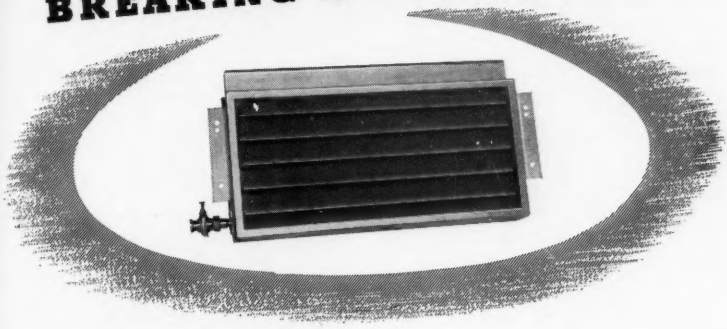

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Fig. 2. Paint being loaded on waterseal. Foreman with stop-watch, calibrated to pump performance, sees that pre-determined gallonage is poured

preliminary test was made by lowering a 40-ft. length of 2-in. pipe in a water-sealed holder tank through a dam made by a bottomless 5-gal. paint can which held 3 gal. of floating paint. The results encouraged further experimentation. Progressively, the complications of initial gravity, viscosity, stratification, emulsification and the like were encountered and solved.

After the ways and means of the flotation method were worked out and proved by the actual painting of gas holders, patents were applied for. They were granted in 1948 and 1949. U.S. Patent No. 2451158 covers the method and U.S. Patent No. 2462368 covers apparatus. Consolidated Edison, however, is not keeping its process to itself, and is willing to grant a licence to any utility company with certain stipulations. Many others have expressed a deep interest, and one, the Philadelphia Gas Works Co., has already put flotation to a full-size test by painting one of its gas holders in this manner.

So far, Consolidated Edison has used the flotation method to paint twenty-nine gas holders with a total lift area of more than 2,500,000 sq. ft.

The standard procedure begins after any necessary hand-scraping and spot priming, a costly operation which Consolidated Edison believes can be eliminated entirely by a proper finish painting interval.

Consolidated Edison's apparatus which is taken to the site, includes a 1,500-gal. tank truck—filled with paint at the supplier's plant, thus eliminating packaging—and an army surplus trailer carrying two screw-type electrically-driven pumps. In addition, there is a portable 2-in. hose ring-line—which can be assembled by means of fast couplings and without hand tools in 3 hours—and other auxiliary equipment.

The ring-line, which has ten circumferential outlets for the gas holder of average size, is placed around the tank walk, which skirts the water seal, and is connected through the trailer pump to the tank truck.

The lift to be painted is inflated with gas so that it rises into the air and the sheets are permitted to dry.

Paint is then pumped to the water seal through the outlets. A stop watch calibrated to pump performance is used to see that a predetermined amount of paint is delivered to the various sectors of the circumference. This distribution is checked with a gauge designed for the purpose, which consists of a float which will sink in paint but float on water. Any defi-

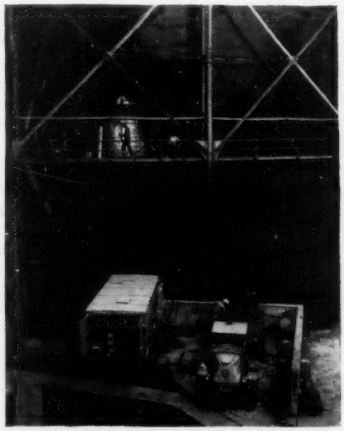


Fig. 3. Consolidated Edison's flotation paint rig. 1,500-gal. tank truck at right picks up paint at supplier's, eliminating packaging. Paint is sent, by pumps in trailer at left, up through riser to water seal

Fig. 4. Same paint, different method after a few years of exposure. Upper section was painted by conventional brush method; bottom, by flotation

ciency in paint volume is then supplied through the ring-line outlets. Gas is then pumped from the holder by the permanent station equipment. As the lift descends, the paint crew does a patrol job to look for any thin spots in the floating paint. If, because of wind conditions or faulty loading readings more paint is required, the appropriate ring-line valves are opened to supply it.

As soon as the lift has reached the limit of its descent, the gas flow is reversed, causing the lift to rise. As it does, the surplus paint flows off on to the surface of the water seal. By reversing the trailer pump connections, this surplus paint is removed from the water seal back through the ring-line to the truck. Any water picked up by this operation is either removed by opening a drain valve in the truck or the combined oil and water is pumped back to the holder for the next lift operation where the separation takes place naturally.

Working a normal schedule for this type of paint job, a six man crew will paint three lifts, about 66,635 sq. ft. the first day, and two lifts, 45,067 sq. ft., the second day.

Cost of material when flotation is used is higher than in conventional painting. This is because more paint is used and the price per gallon is higher because of continued research, development experimentation and so on. Even so, the total cost of Consolidated Edison's first flotation jobs was only 90 per cent. of a conventional job by brush or spray, while the five-year cost, based on performance experience, is only 36 per cent. of any other known method.

Consolidated Edison's biggest flotation job was the painting of a 15,000,000 c. ft. holder at its Astoria gas manufacturing plant, believed to be one of the largest water-seal holders in the world. Because of its great diameter, 296 ft., every foot of vertical travel represented hundreds of sq. ft. of surface. At a rising rate of 15 in. a min., this amounted to more than 69,000 sq. ft. an hour.

The extreme durability of the flotation-applied paint film on water-sealed holder lifts is attributed by Consolidated Edison painting engineers to the following factors: 1. Complete automatic impregnation of the old painted surface regardless of unequal local porosity conditions, i.e., absorption characteristics of the freshly spot-primed area and the adjacent relatively-spongy old paint. 2. Automatic, even distribution of the wet film after unequal surface absorption requirements have been fulfilled. 3. Uniform flow-off of surplus paint because of steady rate of operating movement. 4. Heavy wet film thickness, 4 to 6 mils. without runs or sags.

All illustrations in this article are courtesy of Consolidated Edison Co. of New York, Inc.

Service to Industry.—Under this title we have received from Kaylee Transfers Ltd., West End Mills, Leopold Street, Long Eaton, Nottingham, an attractive brochure giving details of their industrial, decorative and institutional transfers. Throughout, examples of actual transfers are evidence of the variety of industries served.

British Non-ferrous Metals Research Association

THE following extracts from the 32nd Annual Report of the Association will be of interest to readers:

Corrosion in Domestic Waters

It is now established that pitting corrosion of copper in cold natural supply waters only occurs when two conditions are satisfied, namely when the water lacks an inhibitor which is present in most supply waters and when the surface of the copper also carries a highly cathodic film which can, under certain circumstances, be produced in the manufacture of the material. The Association's members manufacturing copper products for service pipes, etc., are accordingly taking precautions to avoid the formation of the film, and, in this connection, some work is being undertaken by the Association in co-operation with its members, and with the suppliers of lubricants used in cold working of copper, to select the lubricants least likely to give rise to cathodic carbonaceous films. Concurrently, the Association has secured the generous collaboration of the Brewing Industry Research Foundation in a search for the identity of the inhibitor.

The general characteristics of this substance and the way in which it inhibits pitting attack are known. If its identity could be established the information might be applied with advantage to the problem of pitting in hot waters where cathodic films are likely to form on the metal surface by deposition from the water. It is not yet known whether the inhibitor prevents pitting in hot waters, since the number of cases is fortunately low, but there is a possibility that the infrequent failures in hot waters might be avoided by a simple water treatment if a suitable inhibitor could be found.

Corrosion in Condenser Systems

The future of this research, one of the oldest in the Association's current programme, was carefully reviewed this year, and it was clear that there is still a need for work in the study of corrosion in condenser systems and other parts of marine water systems. In the year under review, further laboratory tests have been completed on the behaviour of existing materials for marine water service when they are exposed to impingement attack by high velocity water carrying entrained air bubbles. As in the earlier tests, the results have been reassuring in that the proved alloys have stood up well under what appear to be more severe conditions of exposure than are normally encountered in existing equipment.

One of the alloys developed for marine water services is required to be fabricated into various forms with much the same facility as copper and, while this appears to be possible in most cases, some troubles have been encountered in coppersmithing the alloy. It is thought that the reasons for these troubles are largely understood, but further experimental work has been done and is continuing with a view to advising members of manufacturing conditions to produce materials less likely to cause trouble in subsequent fabrication.

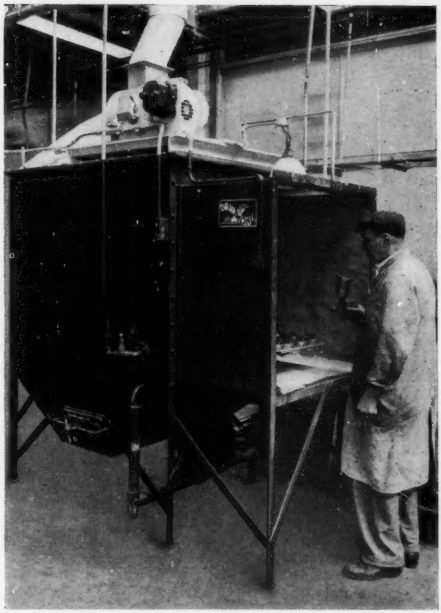
The aluminium brasses, which have deservedly gained an excellent reputation for resistance to impingement attack, occasionally pit in waters heavily contaminated with organic matter, and this subject is among the items of further work now in hand.

Corrosion of Aluminium in Supply Waters

Corrosion tests on a wide range of wrought- and cast-aluminium alloys exposed to supply water at six different sites in the country have been completed and the results reported to members. Concurrently, the factors affecting pitting attack of these materials in such waters have been studied in the laboratory and sufficient results have emerged to warrant some tentative conclusions about the mechanism of this attack. Further experiments to confirm or disprove these views are in hand, and the future work includes exploratory tests of some possible remedial measures.

A new research, to examine the resistance to corrosion of cast and wrought aluminium and various aluminium alloys when buried in a variety of soils, has been begun. It is known that attack is rapid in many soils and a large number

WATER WASH SPRAY BOOTHS *of* GREATER SIMPLICITY *and* HIGHER EFFICIENCY



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of the specimens to be exposed in various sites will be protected in various ways, with a view to selecting methods of protection which can readily be applied by users of these materials.

Conservation of Zinc in Hot Dip Galvanising

A great part of the effort available for work on hot dip galvanising has been devoted this year to large-scale trials in members' works to demonstrate how zinc economies can be effected by applying results of existing knowledge. The Association's investigators spent some time in a typical plant galvanising fabricated sheet steel parts, and showed that by suitable modifications in galvanising practice coatings could be produced which were much more uniform; in consequence, substantial zinc economies were effected. The changes in procedure did not entail reductions in the rate of output. The recommended procedure was in due course demonstrated to a group of members operating galvanising plants, who are being encouraged to apply the same methods in their works.

In addition to economies effected by modifying galvanising practice, it has also been demonstrated that much of the metallic zinc in galvanisers' ash is easily recovered immediately and can be returned to the bath, and the simple process developed for this purpose is now used in many plants. Practical work of this nature is likely to be continued in the immediate future, but further laboratory work has been started to clear up some uncertain points about factors contributing to the formation of zinc-iron compounds which are removed from the bath as dross.

Electropolishing of Non-ferrous Metals

This research was designed to throw light on the mechanism of electropolishing, in the hope that a better understanding of the process might lead to its wider application and, in particular, to its substitution for the laborious and dirty operations involved in mechanical polishing. Unfortunately, the results offer little prospect of attaining this latter objective. It is considered that some of the currently accepted views of the mode of dissolution of an anode in an electropolishing cell are erroneous.

It has been demonstrated that the dissolution of asperities on the anode surface proceeds at a rate determined by the distribution of current in the immediate vicinity of the surface, this distribution being determined by the form of the surface and being substantially independent of the nature of the polishing solution. Hence, it is not to be expected that different polishing solutions will have differing polishing efficiencies, i.e., that one solution will remove a given roughness with the dissolution of less metal than another solution. It appears, therefore, that there is little prospect of finding polishing solutions which will smooth the coarse roughness for which mechanical polishing methods are normally used. It seems likely, therefore, that electropolishing will remain a process with limited applications, notably as a final polishing operation and for the polishing of intricately shaped small parts.

The alternative solutions available may have different merits in respect of initial cost, life, etc., but an assessment of the solutions in this sense requires operation of the processes on a large scale, and no work along these lines is proposed in the Association's laboratory. The research is now discontinued.

Electrodeposition on Aluminium

The study of adhesion of electrodeposits on aluminium has shown that the adhesion depends markedly on the mode of growth of the zinc which is deposited on the aluminium surface by replacement from sodium zincate solutions. It has been shown how this adhesion varies with the composition of the zincate solution and with the conditions of immersion, and that with favourable conditions good adhesion persists after prolonged storage if the overlying nickel plate is thick enough and sufficiently non-porous to prevent blistering by corrosion.

In much of the work to date qualitative adhesion tests have been used, but recently some work has been done on an American quantitative test, applicable to thinly plated surfaces, which involves growing a nodule of a hard metal on the plated surface to form a grip with which the electroplate can be pulled away from the basis metal.

The work is now being extended to another method of plating which involves electrodeposition of the zinc rather than deposition by the replacement method so far studied. The process in its present form involves many steps, and the object of the work is to ascertain whether it can be simplified.

Quality of Nickel and Chromium Electrodeposits

Initially, this research consisted of a study of the causes of roughness which occasionally appears in bright nickel deposits. It has been demonstrated that these defects generally arise from matter suspended in the plating solution and, since the difficulty is not often encountered in practice at the present time, attention is now focused on a more fun-

damental study of the factors affecting microporosity in nickel deposits. It is well known that the porosity of a nickel coating decreases as the thickness of the coating is increased and, as a long term approach to the problem of improving the quality of electrodeposits, a programme of work has been put in hand to assess the importance of various factors believed to contribute to the microporosity. The ultimate objective is to produce non-porous thin coatings and thereby utilise nickel more efficiently as a protective and decorative coating. Similarly, new work is to be started with a view to developing non-porous chromium deposits.

Nickel Economy and Substitutes for Nickel Plating

The current acute shortage of nickel for the electroplating industry has focused attention on economies and substitutes, and a report has been released to members (and subsequently published) recommending practices which can be adopted in plating plants to minimise nickel losses.

For many articles formerly electroplated no nickel is now available, and industry is examining the merits of various possible substitutes. To facilitate this search the Association is arranging co-operative tests of substitute coatings made in members' works and laboratories, with a view to selecting the most promising.

SOLUBLE SILICATES

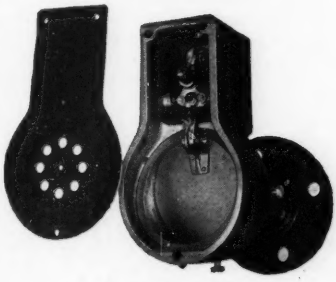
Their Properties and Uses

Reinhold Publishing Corporation—Chapman and Hall, 37 Essex Street, W.C.2. By James G. Vail, D.Sc. 72s.

IN Volume 1, 357 pp., the chemistry of the soluble silicates is dealt with in detail. It is devoted to the theoretical aspects of the subject, mentioning past and present manufacturing processes, the properties of homogeneous and heterogeneous systems of glasses, the formation of metallic silicates and other fundamental material.

The book is primarily of interest to those with experience or a desire to achieve interest in the subject. Data relating to adhesives, significant for coatings and cements, are included. In view of the ramifications of silicate chemistry, extending into a variety of fields, the book is of extreme interest to any research and development department dealing with silicate chemistry.

AIR FLOW SWITCH



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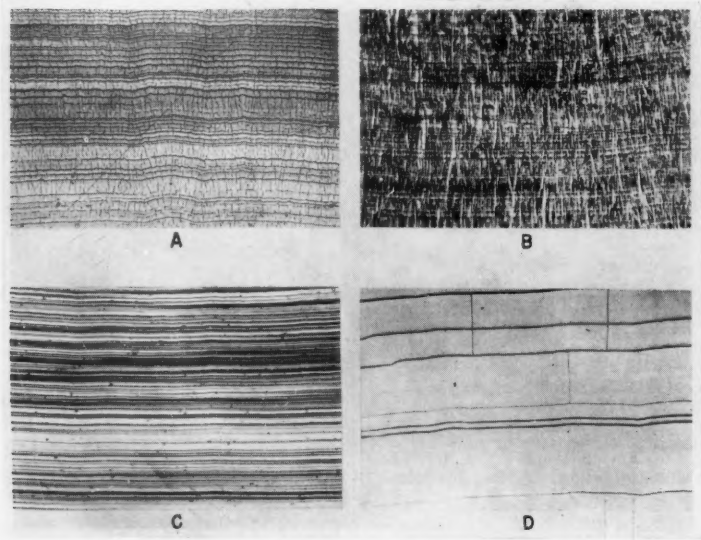
Electrodeposits of Cobalt or Nickel Containing Phosphorous

A COMMERCIALLY feasible method for producing electrodeposits of cobalt or nickel alloyed with as much as 15 per cent. of phosphorus has recently been developed by Abner Brenner, Dwight E. Couch, and Eugenia K. Williams of the U.S. National Bureau of Standards. The new phosphorus alloys are more easily deposited than chromium and are very hard, corrosion-resistant, and bright. They should thus be of value for many of the applications in which chromium plate is now used to obtain a hard, wear-resistant surface or a decorative finish.

Plating baths for depositing the phosphorus alloys are rather simply prepared, consisting of common nickel or cobalt salts such as the sulphate or chloride, to which is added phosphorus acid as a source of phosphorus in the deposit. The baths are operated at a low *p*H—between 0·5 and 1·5 depending on the composition. To maintain the desired acidity in the cathode film, the solution must be buffered. The Bureau has found that phosphoric acid is one of the best chemicals for this purpose. The plating baths are kept at 75° C. or above because at room temperature the cathode current efficiency is very low and the deposits are weak. Current



Photomicrographs of alloys of phosphorus with cobalt and nickel electrodeposited by means of a technique recently developed at the U.S. National Bureau of Standards. The low-phosphorus alloys show a columnar structure while the structure of the high-phosphorus alloys is laminated or banded. A. low-phosphorus nickel (2·3 per cent. phosphorus); B. low-phosphorus cobalt (2·2 per cent. phosphorus); C. high-phosphorus nickel (13 per cent. phosphorus); D. high-phosphorus cobalt (10 per cent. phosphorus). Magnification × 275

Composition of Typical Plating Bath for Depositing Alloys of Phosphorus with Cobalt or Nickel

*Type of Bath**	$NiSO_4.6H_2O$ g/l	$NiCl_2.6H_2O$ g/l	H_3PO_4(100%) g/l	H_3PO_3(100%) g/l	$CoCl_2.6H_2O$ g/l
Low-phosphorus nickel	175	50	50	1·3	—
High-phosphorus nickel† ...	150	45	50	40	—
Low-phosphorus cobalt... ...	—	—	50	1·3	210
High-phosphorus cobalt† ...	—	—	50	40	180

* *It is very important that the* pH *of the baths listed be less than* 1·0.
† *The* pH *of the high-phosphorus baths should be raised to a value between* 0·5 *and* 1·0 *by adding nickel or cobalt carbonate.*

densities should be between 5 and 40 amps. per sq. dec. At the usual current density—about 10 amps. per sq. dec.—the rate of deposition is fairly high, amounting to a few thousandths of an inch an hour.

The appearance of the deposits depends upon their phosphorus content. Alloys with less than 2 per cent. of phosphorus are usually smooth with a matt finish; but as the percentage of phosphorus increases, they become brighter, reaching a peak of brightness at a phosphorus content of about 10 per cent. When such deposits are plated on a dull surface, they increase in brightness as they become thicker. As a result of the slightly dark cast of the high-phosphorus alloys, their reflectivity is 45 to 50 per cent., as compared with about 60 per cent. for buffed nickel coatings.

When some of the phosphorus alloys are immersed momentarily in a solution of an oxidising agent, such as ferric chloride, or made anodic in the plating bath, a jet black film is formed on the surface of the metal. This film is hard and adherent and appears to have possibilities for decorative use.

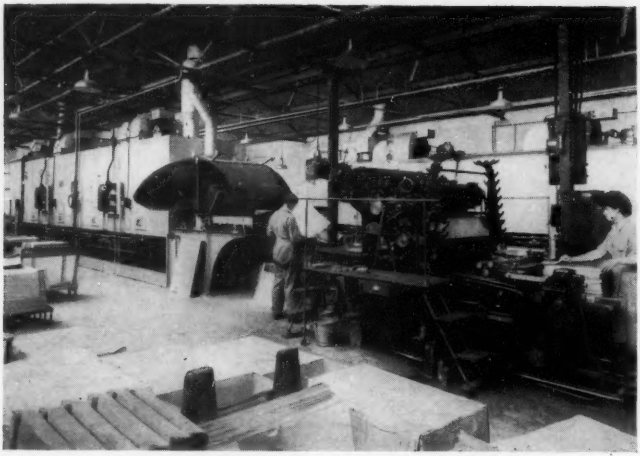
Photomicrographs of the low-phosphorus alloys show a columnar structure while the high-phosphorus alloys are found to have a laminated or banded structure. X-ray diffraction patterns of the high-phosphorus alloys show no crystalline structure. When heat-treated, the deposits develop a fine-grained structure instead of the large crystals characteristic of pure nickel or cobalt.

The hardness of the deposits as plated varies from 350 to 720 on the Vickers' scale, increasing with phosphorus content. When the alloys are heat-treated at 400° C., they become much harder. For example, a heat-treated cobalt-phosphorus deposit containing about 10 per cent. of phosphorus reaches a hardness of over 1,100 Vickers, which is greater than that of electrodeposited chromium. Deposits which have been heated as high as 800° C. and cooled are not appreciably softer than the initial deposit. However, the alloys have poor "hot hardness" and above a temperature of 600° C. are softer than unalloyed nickel or cobalt.

Although the low-phosphorus alloys become ductile after heat treatment at 800° C., deposits containing more than 1 per cent. of phosphorus are generally brittle. Alloys with higher percentages of phosphorus are highly resistant to corrosion and chemical attack, exceeding in this respect the pure metals. Thus, in experiments at the Bureau, the nickel alloy with 10 to 14 per cent. of phosphorus was attacked considerably less by hydrochloric acid than was pure nickel.

The pleasing appearance, ease of deposition, hardness, and corrosion resistance of the new alloys suggest the possibility of a number of commercial applications.

Although the phosphorus alloys are not as white as bright nickel, the operation of the baths is much less critical than for proprietory bright nickel. The phosphorus alloys can be plated from a bath made up entirely of inorganic chemicals, whereas bright nickel-plating solutions must contain an organic brightening agent.



One of the 30 ft. "Ballard" ovens. Sheets are fed directly into these as they come off the printing press.

TIN BOX MANUFACTURE

THE Self-Opening Tin Box Co. Ltd., which has its works in the London Road, Barking, is an interesting link with the earliest days of the manufacture of boxes made from tinplate sheeting. The term itself was but one of the many superlatives arising during the welter of nineteenth century developments so often accompanied by exaggerated claims regarding performance and function. This one stands as a particularly good example, distinguishing as it did the openable tin box from its predecessor.

The so-called self-opening tin box arrived on the scene as a new invention at a time when tin box-making was a service to the food processing industries in vacuomatically sealed containers. Hence it will be seen that the development of the openable tin box marked a radical departure from the limitations of the early days of the industry whilst the incorporation of the words "self-opening tin box" into the title of the undertaking can well be understood.

As far back as 1813, Edward Charles Howard invented the vacuum pan, and it is said that Napoleon Bonaparte was prompting attempts to develop the preservation of milk in a condensed form as a portable foodstuff. From these early experiments grew the evaporated milk processing industries and the sealed tinplate containers essential to its preservation.

Thus the importance of the new invention and the formation of the Self-Opening Tin Box Co. Ltd., which entered into production in the year 1880. One of their early contracts was in the making of 14 lb. biscuit containers for the Boer War. The company's output now includes every type of box produced from tinplate, from the small kind to hold a favourite brand of tobacco or an unfailing medical remedy, to the large containers for paint and other industrial preparations, irrespective of size, shape or special requirement.

As a rough assessment of productive capacity it is necessary only to mention the fact that some 10 tons of tinplate are daily converted to these various types and sizes of boxes following a number of processes involving heat

treatments at certain stages. The company are large users of gas and their layout in this respect is most impressive.

The general method of tin box-making may seem simple enough beginning with the cutting of the sheets of tinplate and shaping for the body of the box, and cutting and pressing the tops and bottoms in such a way as to include rimmings for strength, and as a soldering key when the components are brought together later for assembly.

In all these operations close limits are set for cutting out the blanks to ensure accuracy for fitting the parts together, and as an economy in the use of valuable materials. The importance of working to close limits is emphasised in the production particularly of the airtight, lever lid container and in the filling of special orders.

The engineering department of the company is responsible for guaranteeing these close-working limits in the production of the dies, etc., required for the earliest operations.

Tin Printing

Before these operations are undertaken, however, where the finished articles are not to be covered with wrappers or labels, the metal sheets pass through a process of tin-printing.

This operation may be completed in straightforward typeset matter, giving a description of contents, instructions and so on, or may include trade-marks and pictorial effects in attractive colour combinations. It is a normal printing process by the offset method, selected for its particular suitability in printing on to tinplate, and is equal to any similar operations in printing on to paper. It is an interesting tribute to tin printing that whilst tin boxes are frequently put to a variety of other uses when their contents are exhausted, attractively printed boxes finished in colourful designs are often retained solely for their decorative appeal.

In conjunction with tin printing, other operations involved include lacquering, enamelling and varnishing whilst each printing impression is followed by drying. These stages are rapidly completed by conveyorising through one of the well-known "Ballard" gas-fired ovens, two of which are at present in service. A coating may be used to prepare the tinplate sheet for printing, and when printing is completed a final covering of varnish gives full protection to the printed impressions during manufacture, transport and in the hands of the ultimate user. The gas-fired drying ovens are 30 ft. long and the sheets are fed directly into these as they come off the printing press.

Lacquering is a process frequently employed in fruit preservation to withstand the acid action of the juices inside the tin. After application the articles are stoved in a further "Ballard" gas-fired oven having a length of 70 ft. The arrangement of the printing and coating machines is such that both feed their output into the gas-heated ovens continuously at the rate of thousands an hour.

A third gas-fired oven, also of the "Ballard" design, is in its final stages of assembly and this will have a capacity of 5,000 pieces an hour.

Automatic Soldering

The tricky, yet here speedy stages of box-making, lie in the assembly of the parts for the important process of soldering. This is the finale to the construction of a container which is airtight and has the solidity and strength both to hold a weighty material such as paint, and to withstand the rigours of handling and transport before reaching the customer. In the early days of the industry soldering was entirely a hand operation, and a training period was necessary for its successful application, although an automatic machine received its patent as far back as about 1900. The general adoption of the principle of automatic soldering, however, did not come about until a much later date, and followed the lapse of the original patent. Today soldering has been revolutionised into an automatic operation, these works being equipped with five machines made by Green and Luxton Ltd., Byne Road, London, N.W.3.

Each of these automatics is fitted with a gas-heated melting pot thermostatically controlled to maintain the solder at the right temperature. Zinc chloride is added to the solder in the melting pots to prevent dross formation whilst an agitator both helps to ensure a steady flow to the soldering

point, and to serve as an added factor for a dross-free metal. The articles are fed on to a moving gear and, according to size, 500 boxes may pass through for automatic soldering in one hour whilst the arrangement of the machines is such that a number of operations are possible as a continuous process when bottoms, sides and tops are neatly sealed by the gas-heated machines. On the spot inspection eliminates any articles showing flaws.

For the considerable consumption of gas supplied by the North Thames Gas Board, two compressors are on duty to raise the pressure for the ovens and soldering machines. The compressor equipment is a product of Keith Blackman Ltd., Mill Mead Road, London, N.17.

An interesting feature of the gas installation is the overhead lead-in of the supply from the Board's mains whilst the internal lines carried under the roofing are readily accessible with colour identification for quick recognition.

The working capacities of the drying and stoving ovens, 2,000 to 3,000 pieces an hour, the steady stream of articles moving along the soldering machines, serve as a most impressive example of tin box production and the unfailing part played by gas as a fuel at every point where heat is required to make available the tens of thousands of containers in a variety which it is difficult to imagine, which pass continuously overhead on the conveyor to the despatch department.

In the course of a year, gas is used in the drying and stoving ovens, and in the soldering machines to give a production of finished articles in the region of 25,000,000 containers. Surely a most outstanding performance, a justification for the company's pride in its undertaking and its appreciation of the efficiency of the gas-fuelled installations and the co-operation of the North Thames Gas Board.

For the information contained in this report, acknowledgments are made to the Self-Opening Tin Box Co. Ltd., and to the North Thames Gas Board.

The Corrosion of Steel Under Phosphate Coatings and Protective Finishes

THE efficiency of phosphate coatings on steel as protection against corrosion, and the means of testing this efficiency and corrosion resistance in general were discussed at a meeting in London on 28th October. The meeting was organised by the Iron and Steel Institute in conjunction with the British Iron and Steel Research Association, with Mr. H. T. Shirley, chairman of the Corrosion Committee, of B.I.S.R.A., in the chair.

Four papers were presented and discussed: "Phosphate Coatings as a Basis for Painting Steel," by the Phosphate Coatings (Drafting) Panel of the British Standards Institution; "Corrosion by Retained Treatment Chemicals on Phosphated Steel Surfaces," by S. G. Clarke and E. E. Longhurst; "Tentative Analytical Tests for Phosphate Coatings on Steel," by R. St. J. Preston, R. H. Settle and J. B. L. Worthington; "Second Report of the Methods of Testing (Corrosion) Sub-Committee."

The first three papers were discussed together. The first was presented by Dr. J. C. Hudson, the second by Dr. Longhurst and the third by Mr. Preston. Dr. Hudson recalled that the initial purpose for which the Panel had been set up in 1944 was to consider tests of phosphate coatings and stoving paints for the Ministry of Works in connection with the large number of prefabricated houses then being built. B.S.I. Publication PD539 of 1946 had resulted from the Panel's work; this was really a code of practice, rather than a performance specification. It had proved useful, but the need remained for more specific tests, both analytical and performance.

The present paper described the results obtained when analytical and performance tests were applied to industrial phosphate coatings.

Analytical tests included determination of

(1) Weight per unit area.
(2) Phosphate content.
(3) Moisture control.
(4) Hygroscopicity.
(5) Absorption value.

The performance tests used were the A.R.E. sea water droplet test, the C.R.L. sulphur dioxide test and outdoor exposures.

The main difficulty met with in considering specification was the wide variation between phosphating processes in current use both in coating weight and PO_4 content. The accompanying Table shows some of these variations, as revealed by analytical tests on six types of industrial phosphate coatings. Each process, however, was satisfactory for the purpose for which it was intended, and field tests had in fact shown that wide variations in the weight of phosphate coatings applied by the same process had no effect on coating efficiency when overpainted.

In spite of this, it might be possible to draw up specifications for individual processes, if each specification were strictly limited to the particular process concerned and if the criteria of acceptance were suitably related to the purpose for which the phosphate coating was required. Such specifications might be based on a performance test for a specimen phosphated by the process under examination, and provided with a standard organic finish of oil, lacquer or paint. Experimental work to explore this possibility was in progress.

Dr. Hudson said that the B.S.I. Panel had studied the effect of chromic acid additions to rinsing water on two industrial phosphate coatings. Small concentrations of chromic acid had a beneficial effect on the protective properties of the coatings, but a high concentration dissolved the coatings. The permissible limiting concentration of chromic acid probably varied for different phosphating processes, but even very dilute solutions with concentrations as low as 0.05 per cent. might have a beneficial effect. The optimum concentration was probably about 0·1 to 0·2 per cent.

Washing After Phosphating

Dr. E. E. Longhurst introduced the second paper on corrosion by retained treatment chemicals, which, he pointed out, concerned hot bath phosphating only. The work was directed to answer the question: "How far is it necessary to wash the steel parts after phosphating?"

The answer varied, as might be expected, with the type of phosphating solution. In general, the risk of corrosion from solutions trapped in crevices or folds was less with the plain metal phosphate-phosphoric acid type bath than with accelerated phosphating solutions containing other constituents more active in stimulating corrosion.

Even with the plain type bath it was probably desirable to wash creviced parts after phosphating, though a relatively simple washing treatment to remove excess solution from recesses or from the mouths of crevices would be sufficient. With phosphating solutions containing other active constituents, washing was generally essential to remove residual corrosive solutions.

Dr. Longhurst supported these conclusions by a series of slides showing the condition of painted panels after test. He then suggested a simple performance test as a guide to the corrosive tendency of a solution if it was not known, or if the geometry of the parts treated made effective washing difficult. This test involved exposure of the parts to be examined to damp air for a period of one week, in which period any dried-out corrosive residues would tend to absorb moisture and become active.

In introducing the third paper on analytical tests for phosphate coatings, Mr. Preston said that there were two possible lines of development. The first concerned the composition of the coating and the second concerned the coating's anti-corrosive qualities.

Laboratory tests to determine the composition of the coating included the measurement of moisture content, phosphate content (for which two simple tests had been developed) and chromate content. Tests to indicate the anti-corrosive qualities of the coatings included absorption value, coating weight and hygroscopicity.

Mr. Preston said that the last-named was a most important factor. Accelerators used in industrial processes introduced salts, which might attract water. For example, one firm of his acquaintance had encountered blistering due to salts contained in mains water; the difficulty had been overcome by an alteration in the process.

Discussion

The favourable results obtained from plain types of phosphating bath by Dr. Longhurst were commented on by Mr. R. J. BROWN (Morris Motors Ltd.). He said that these baths would be uneconomic in practice for many assemblies owing to the length of processing time. He suggested that the dip wash with very little agitation that Dr. Longhurst had employed might vitiate the comparison of his results with those from similar phosphate treatments which embodied a very efficient rinse with sprays.

Mr. Brown described how ring blistering of motor body finishes had been caused by water spots dropping on to clean body surfaces from overhead condensation points after phosphating and before painting. Even after continuous processing

ANALYTICAL TESTS ON INDUSTRIAL PHOSPHATE COATINGS

Process	*P*	*S*	*T*	*Q*	*V*	*R*
Main cation in phosphate bath... ...	Fe	Mn	Zn	Zn	Zn	Zn
Method of application	Immersion	Immersion	Spraying	Immersion	Immersion	Immersion
Duration of treatment, min.	15·0	30·0	1·5	4·0	5·0	12·0
Change in weight on phosphating, g/sq. ft.	−2·40	−2·43	0·24	0·31	0·15	0·54
Coating weight, g/sq. ft.	1·31	1·95	0·41	0·50	0·32	1·13
PO_4, g/sq. ft.... ...	0·64	0·82	0·18	0·19	0·11	0·41
Moisture, mg/sq. ft....	7·5	7·0	14·0	34·0	16·0	71·0
PO_4, content of coating, %	49·0	42·0	44·0	38·0	34·0	36·0
Moisture content of coating, %... ...	0·6	0·4	3·4	6·9	5·0	6·4
Hygroscopicity of coating, %... ...	0·3	0·2	1·2	1·3	1·0	1·5
Absorption value, g./sq. ft.	1·05	1·0	1·0	1·2	1·0	1·1

equipment had been introduced, trouble was encountered in the form of "snail trails," which were lines of fine blisters at the interface of the phosphate coating and the primer paint. An analysis of the rust associated with them showed the presence of calcium and chlorides. It appeared that incrustations of soluble salts in the overhead structure were being redissolved and were dripping on to the surfaces of the bodies. Further, one of the processing solutions used in the plant was acting as a source of chlorides. Correction of these two factors achieved a major reduction in "snail trails" but not their complete elimination from the plain body surfaces. The last source of contamination was found to be one which had been suspected quite early in the story; the water supply used had a total hardness of 40 parts per 100,000. The volume of water consumed put out of the question the use of treated water such as boiler condensate, so that it was considered necessary to prevent localised evaporation of the water contained on the body surface. Sprinklers were used for this purpose.

The corrosion trails were still not completely eliminated, but the final step was taken with the advice of the C.R.L. This consisted of the operation of the chromic rinse without heating and the prevention of rotation of the bodies (the cars are held on a spit during the process) between the chromic rinse and the forced drying. Uniform drying was then possible over the entire body surface without the formation of trails of soluble salts.

MR. R. F. DRYSDALE (Walterisation Co. Ltd.) reported work broadly parallel in nature to that described by Dr. Longhurst, but mainly concerned with lightweight coatings applied both by accelerated and non-accelerated processes. He had had the best results from specimens treated with non-accelerated processes which had been dried unwashed; there was little to choose between those washed with water, chromic acid or soluble chromate solutions. Samples washed with a 0·03 molar phosphoric acid solution were comparable with those dried unwashed. In his view these differences in behaviour were associated with imperfect coating deposition within the seams owing to the poor circulation and, consequently, the exhaustion of the phosphating solution at such places.

Failure at Seams

MR. A. NICHOLSON (Pyrene Co. Ltd.) considered the question of rinsing generally. He thought that, even with unaccelerated processes, rinsing was advisable when the parts were to be subsequently painted. There would otherwise be risk of osmotic failure of the paint film. He suggested that a cause of failure at seams was incomplete coating formation. Cleaning inside the seam was the first and most difficult obstacle in this case. Accelerated processes, by virtue of their lower temperatures, strengths and treatment times, could be less active than unaccelerated processes in these particular conditions. Production considerations of time and space necessitated the use of accelerated

FUEL ECONOMIST

EDITORIAL DIRECTOR: W. F. Coxon, M.Sc., Ph.D., F.R.I.C., F.I.M., M.Inst.F.

fortnightly

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processes, and means were available to deal with seam problems if they arose. For example, he had known one case where seam trouble had been cured by actually increasing the accelerator concentration of the solution.

He thought that a final rinse containing a small amount of phosphoric acid as well as chromic acid might be beneficial. The authors had mentioned a German patent concerning the use of a final rinse with zinc phosphate, which appeared to be comparable.

MR. E. J. BRIMELOW (Building Research Station, D.S.I.R.) suggested there were dangers in assessing phosphate coatings by accelerated corrosion tests, particularly to determine the most useful concentrations of chromic acid in the rinsing solutions.

In reply to the discussion, Dr. Hudson agreed with Mr. Brimelow that caution was necessary in such cases, and re-emphasised that the optimum chromic acid concentration varied for different phosphating processes.

Dr. Longhurst replied, commenting that Mr. Brown's interesting contribution related to a spray washing procedure, in which the car bodies being treated were never fully immersed and at times were fully exposed. Rapid evaporation had occurred from the hot exposed surfaces, allowing concentration of soluble salts on the surfaces. These conditions varied considerably from those obtaining during treatment and washing by full immersion processes. He explained that in his own tests corrosion had occurred owing to the presence of certain constituents of residual phosphating solutions, and not by the action of added corrosive agents such as the salt spray in Mr. Drysdale's tests. He agreed that it appeared that small concentrations of phosphoric acid residues were not necessarily dangerous. In industrial practice, however, it was difficult to avoid major concentrations of phosphoric acid, owing to seepage from crevices or inefficient drainage on awkwardly-shaped components. Minor defects would occur where such concentrations occurred, and, generally, he was in favour of a quick rinse in even the most favourable circumstances.

Replying to Mr. Nicholson, Dr. Longhurst said that in the work described by Dr. Clarke and himself, they had not studied the efficiency of phosphating within the crevices, but only the corrosivity of treatment solutions seeping on to the exposed surfaces outside the crevices. He confirmed that nitrate had been detected chemically near the crevice mouths on the specimens which had been phosphated by the accelerated process and subsequently washed.

Introducing the Second Report of the Methods of Testing (Corrosion) Sub-Committee, Dr. Hudson said that as a result of the Sub-Committee's work two laboratory tests for resistance to corrosion had been standardised and would shortly be published as B.S. 1,391:1952. These were the A.R.E. salt droplet test and the C.R.L. test, which were based, respectively, on tests originally designed by the Armament Research Establishment and the Chemical Research Laboratory.

The development and standardisation of these tests had involved collaborative work in many different laboratories. In some respects the reproducibility of the tests was not all that might have been wished, but it was generally as good as was to be expected in this type of experiment.

Dr. Hudson observed that reproducibility must be affected by the fact that any order of merit of a number of protective schemes could vary with the conditions of exposure, the type of service and the criterion on which failure was assessed. It was doubtful whether a laboratory test would ever give a hard and fast correlation with the results of service. Their best function was probably to ensure reproducibility of a given standard for a protective scheme of a given type. They were of great value in weeding out unsatisfactory protective schemes, but became fallible when it was a case of distinguishing between several good or excellent protective schemes.

In the Sub-Committee's attempts to adjust the criteria of failure so that a protective scheme would be equally likely to fail from general rusting or from the effects of damage, he thought that there might have been some tendency to exaggerate the effects of damage on performance. Often, although failure occurred at a damaged area, rusting remained localised and might even be stifled. In the new British Standard B.S. 1,391:1952, therefore, the infliction of damage before testing had been made optional, so that a user expecting damage to be the determining factor under his particular service conditions, could use the standard methods of damage before the tests. Otherwise, the tests could be carried out on undamaged specimens.

Elliott Brothers (London) Ltd.—Elliott Brothers (London) Ltd., manufacturers of electrical, electronic and process control instruments, announce the transfer of their Birmingham branch office to larger and more modern premises at 181 Corporation Street, Birmingham 4 (Telephone: Central 8313).

Pretreatment Etch Primers of the Single Solution Type

PART III

by E. E. HALLS

IN the first part of this article the author gave details, together with a summary of conclusions, of comparative tests upon single solution etch primers from three different sources of supply (Nos. 1, 2 and 3) against a good two-solution etch primer (No. 4). The following tables, together with those appearing in the November, 1952 issue of INDUSTRIAL FINISHING, show the results obtained.

TABLE 5.
FINISHES ON ALUMINIUM—PERFORMANCE UNDER HOT WET TEST

Sample No.	*Finish*	*Primer No.*	*Test Period Days*	*Performance*	*Remarks*
1	Primer only, air dried for 1 day	1	1	No blistering or flaking, film resistant to thumb nail scratching, although a little soft in some areas. Condensed water on panels yellowish.	Good
			2	No change.	
			4	Film becoming soft and removable with thumb nail, but recovering after one day's air drying.	
			7	No flaking or blistering, and after air drying for a week, film hard and adherent, and resistant to finger nail scratching.	
			26	Ditto. Scratch test perfect, bend test satisfactory without flaking, but could be scraped off along bend.	
2		2	1 to 26	Exactly similar to sample No. 1, except rather better on bend test.	Good
3		3	1	No apparent change, no discoloration of condensed water. Film still hard and resistant to thumb nail.	Moderate
			26	No blistering or flaking. After recovering by air drying for a week, film still soft. Scratch test satisfactory, but film felt soft. Bend test, satisfactory.	
4		4	1	No apparent change, no discoloration of condensed water. Film hard and resistant to thumb nail scratching.	Very good
			26	No blistering or flaking. After recovery by one week air drying, film firmly adherent and resistant to finger nail scratching. Scratch test perfect. Bend test satisfactory but enamel could be scraped from bend with thumb nail with difficulty.	

Sample No.	Finish	Primer No.	Test Period Days	Performance	Remarks
5	Primer only, stoved 20 min. at 250° F.	1	1	No flaking or blistering. Film perfectly adherent to thumb nail scratching. Water condensed on panel yellowish.	Good
			4	Little change except film soft when examined immediately from test cabinet.	
			7	Examined after recovering at room temperature for a week, film showed no deterioration from condition after 1 day's test.	
			26	No flaking or blistering. After drying out for a week at room temperature, film hard and firmly adherent to thumb nail scratching. Scratch test perfect, bend test satisfactory although film could be removed along bend by thumb nail scratching.	
6		2	1 to 26	Exactly as sample 1, except bend test perfect.	Very good
7		3	1 to 26	Exactly as sample 2.	Good
8		4	1 to 26	Ditto.	Good
9	Primer air dried 1 hr. and cellulose enamel	1	1	No flaking but covered with tiny blisters. Film could be removed with thumb nail. Water condensate yellowish. After air drying for 1 week, still failed thumb nail test, scratch test showed film brittle, causing bad chipping. On bend test film powdered and could be brushed off. Base metal bright and free from corrosion.	Poor, test discontinued
10		2	2	No visual change, but, examined straight from the test chamber, both coats could be scraped off with thumb nail.	Moderate
			4	Further deterioration shown by fine checking.	
			7	No visual change. Examined after 1 week, of air drying, film adherent to thumb nail.	
			26	No visual change. Examined after a week's recovery at room temperature, scratch test satisfactory although enamel coat seemed brittle, and bend test satisfactory except that enamel and primer could be scraped off bend with thumb nail.	
11		3	1	Water condensate, coloured yellow.	Very good
			7	Film beginning to check.	
			26	Examined after recovery for a week at room temperature, scratch test perfect, bend test satisfactory and film scraped off bend only with difficulty.	
12		4	7	Signs of checking.	Very good
			26	Exactly as sample No. 11.	
13	Primer air dried 2 hr.	1	1	A little more resistant to thumb nail scratching but otherwise similar to sample No. 9.	Test discontinued Poor
14	and cellulose	2	1 to 26	Closely similar to sample No. 10.	Moderate
15	enamel	3	1 to 26	Closely similar to sample No. 11 except checking less apparent.	Very good

Sample No.	*Finish*	*Primer No.*	*Test Period Days*	*Performance*	*Remarks*
16		4	1 to 26	A little superior to sample No. 12.	Very good
17	Primer stoved 20 min. and cellulose enamel	1	1	A few blisters but film resistant to thumb nail scratching. Water condensate yellowish.	Test discontinued Rather poor
			2	Tiny blistering general. Film no longer resistant to thumb nail scratching.	
			4	Entire surface blistered. After a recovery period at room temperature, film could still be removed with thumb nail. Scratch and bend tests satisfactory, although film could be scraped off the bend easily with the thumb nail.	
18		2	1	Many tiny blisters. Film not resistant to thumb nail scratching. Condensed water yellowish.	Rather poor
			2	Signs of crazing.	
			4	Film matt.	
			7	Film more adherent on thumb nail scratching.	
			26	Little further visual change. Enamel removable with thumb nail, but primer adherent. Scratch test bad chipping. Bend test satisfactory but finish could be scraped off bend with thumb nail.	
19		3	1	No visual change.	Good
			4	ditto.	
			7	A few patches of blisters, film crazing, loss of colour, but film resistant to finger nail scratching.	
			26	Little further apparent change. Enamel coat removable with thumb nail but primer adherent. Scratch test perfect. Bend test satisfactory but finish could be scraped off bend with thumb nail.	
20		4	1	Unchanged.	Very good
			7	Very fine crazing. No blistering. Resistant to thumb nail scratching.	
			26	No further deterioration. Scratch test perfect, bend test satisfactory and film could only with difficulty be scraped off the bend.	
21	Primer stoved 1 hr. and cellulose enamel	1	1	General blistering. Test discontinued. After recovering at room temperature, film chipped and powdered on scratched test, and cracked and powdered on bend test.	Poor
22		2	1	No apparent deterioration.	Fairly good
			2	Slight crazing.	
			26	Enamel coat could be scraped off the primer with thumb nail. No flaking or blistering. Scratch test satisfactory although enamel coat tended to be brittle. Bend test satisfactory, but finish could be scraped off bend with thumb nail.	
23		3	7	Little apparent deterioration other than slight crazing.	Good

Sample No.	*Finish*	*Primer No.*	*Test Period Days*	*Performance*	*Remarks*
			26	No blistering or flaking and firmly adherent to thumb nail scratching. Scratch test perfect, bend test satisfactory, but film could be scraped off the bend with the thumb nail.	
24		4	1	Slight checking.	Good
			4	Checking more apparent, but no blistering or flaking.	
			7	Severe loss of colour in patches, but no blistering or flaking, and firmly adherent to finger nail scratching.	
			26	No further deterioration. Scratch test perfect, bend test satisfactory but enamel could be scraped off along bend.	
25 & 29	Primer air dried for 1 hr. or for 2 hr. and stove enamel	1	1	Generally blistered and film soft. After recovering at room temperature for a day, film was resistant to finger nail scratching. On scratch test, film brittle and chipped badly. On bend test, flaked away from the base metal.	Poor, test discontinued
26 & 30		2	1	Little apparent change.	Moderate
			2	A few blisters.	
			26	Some loss of colour and gloss, and increase in blisters. Film adherent to thumb nail scratching. Scratch test perfect except in blistered areas. On bend test, cracking along bend, and film could be scraped off bend with thumb nail.	
27 & 31		3	7	No blisters formed. Severe loss of colour.	Good
			26	No flaking or blistering, film resistant, to thumb nail scratching. Scratch test perfect. Bend test satisfactory and finish scraped from bend only with difficulty.	
28 & 32		4	26	Stained, loss of gloss and colour. No blistering or flaking. Adherent to finger nail scratching. Scratch test perfect. Bend test satisfactory but film could be scraped off bend in some places with difficulty.	Very good
33 & 37	Primer stoved 20 min. of 1 hr. and stoved enamel	1	1	Tiny blisters general, film could be scraped off. Tested after recovering for one day at room temperature, panels failed scratch test by chipping, and failed bend test by flaking.	Poor
34 & 38		2	1	Much blistering and film removed by thumb nail. After recovery for 1 day, failed scratch and bend tests by chipping and flaking.	Poor
35 & 39		3	4	A few small blisters. Discoloured.	Very good
			26	No further blistering or flaking. Film firm to thumb nail scratching. Scratch test perfect. Bend test satisfactory and film scraped off the bend only with difficulty.	
36 & 40		4	26	Loss of colour and gloss. No blistering or flaking. Film resistant to thumb nail scratching. Scratch and bend tests perfect.	Very good

TABLE 6.
FINISHES ON BRASS—PERFORMANCE UNDER HOT WET TEST

Sample No.	*Finish*	*Primer No.*	*Test Period Days*	*Performance*	*Remarks*
1	Primer only air dried	1	1	No flaking or blistering. Film resistant to thumb nail scratching. Condensed water yellowish.	Very good
			7	Film lost resistance to thumb nail scratching, but still no blistering or flaking.	
			14	No further deterioration. Scratch and bend tests perfect.	
2		2	7	A few small blisters appeared. Film resistant to thumb nail scratching.	Good
			14	Loss of colour, otherwise no marked deterioration. Scratch and bend tests perfect.	
3		3	14	Slight loss of gloss and colour. No flaking or blistering. Scratch and bend tests perfect.	Very good
4		4	14	Little visual signs of deterioration. No flaking or blistering. Scratch and bend tests perfect.	Very good
5	Primer air dried and cellulose enamel	1	1	Some small blisters, no flaking. Thumb nail resistance fairly good.	Rather poor
			14	No further deterioration. Slight chipping on scratch test. Cracking on bend test and easy to scrape off bend with thumb nail.	
6		2	1	Numerous tiny blisters.	Poor
			2	Blisters more numerous and film crazing.	
			14	Slight chipping on scratch test. Cracking on bend test and film easily scraped off bend with thumb nail.	
7		3	1	Generally covered with blisters.	Poor
			2	Blisters larger and film crazing.	
			14	Chipping on scratch test. Cracking on bend test, and film easily scraped off bend with thumb nail.	
8		4	4	Crazing of film, but adherent to thumb nail.	Very good
			14	No blistering or flaking. Scratch test perfect. Bend test satisfactory and film could only be scraped off bend with difficulty.	
9	Primer only stoved 20 min.	1	14	No flaking or blistering. Scratch and bend tests perfect.	Very good
10		2	14	A few tiny blisters, no flaking. Scratch and bend tests perfect.	Very good
11		3	14	No flaking or blistering. Film a little soft but perfect on scratch and bend tests.	Very good
12		4	14	No flaking, or blistering. Perfect on scratch and bend tests.	Very good
13	Primer stoved and cellulose enamel	1	1	General blistering. Resistance to finger nail scratching fair. After recovering for a day at room temperature, failed badly on bend test, film flaking away.	Test discontinued Poor
14		2	1	Numerous blisters.	Poor
			2	Crazing of film. No flaking.	
			7	Little further change.	

Sample No.	Finish	Primer No.	Test Period Days	Performance	Remarks
			14	Chipping on scratch test, cracking on bend test, and film could be scraped off bend with thumb nail.	
15		3	1	Generally blistered and easily scraped off with thumb nail.	Poor
16		4	1	No flaking or blistering. Slight crazing.	Very good
			7	Crazing more apparent.	
			14	No blistering or flaking. Film resistant to finger nail scratching. Scratch test perfect. Bend test satisfactory but film could with difficulty be scraped off bend with thumb nail.	
17	Primer stoved and stoved enamel	1	1	Generally blistered and film removable with thumb nail. After recovery at room temperature for a day, film hard and resistant to thumb nail scratching. Chipped badly on scratch test, and flaked completely away on bend test. Metal surface spotted with corrosion.	Poor
18		2	1	Blisters along edge and a few on surface.	Poor
			14	Tiny blisters numerous. Chipping on scratch test, flaking on bend test.	
19		3	1	Blistered and easily removed with thumb nail. After recovering for a day at room temperature, scratch and bend tests poor.	Poor
20		4	14	No flaking or blistering. Scratch and bend tests perfect.	Very good

INSTITUTE OF METAL FINISHING

THE annual Midlands Dinner-Dance will be held at the Grand Hotel, Colmore Row, Birmingham, on Thursday, 15th January, 1953. The reception by the chairman of the Midlands Branch, Mr. W. F. B. Baker, and Mrs. Baker, who will be supported by the president and Mrs. H. Silman, will be from 7 p.m. to 7.30 p.m., when cocktails will be available. Dinner will be served at 7.30 p.m.

Members from the London Branch, the Sheffield Branch and the North-West Branch and their ladies are most cordially invited to join the Midlands Branch on this occasion.

J. & N. VETERANS' CLUB

THE second annual dinner of the Jenson and Nicholson Veterans' Club was held on Friday, 28th November, at the Café Royal. The event was attended by some ninety veterans with twenty-five years' service and over with Jenson and Nicholson Ltd., the majority of whom are still in active service with the company.

In his opening speech, Mr. B. J. Nicholson, M.B.E., chairman and managing director, revealed that Jenson and Nicholson (India) Ltd. were at the same time holding their first Veterans' Dinner in Calcutta, presided over by Mr. John Nicholson, general manager. Greetings were exchanged by telegram between London and Calcutta during the evening. Among those present were Mr. T. H. Vinnicombe and Mr. H. E. Kimber (directors).

"The Bonderizer".—A Brockhouse Engineering (Southport) Ltd. product—the Indian Brave 248 c.c. side-valve motor-cycle, and the part played by the Pyrene Co.'s product "Pylumin," and "Bonderizing" and "Parkerizing," is described in the November/December, 1952, issue. Reference is also made to the Dayton "Roadmaster" cycle and the use of Pyrene pre-treatment products as well as the use of "Parco-Lubrite" by the Standard Motor Co. Ltd. An additional mention of this latter product is with specific reference to fuel vacuum pumps by the AC-Delco Division of General Motors Ltd.

Methods and Machines

THE following items are extracted from *New Methods and Machines*, a digest of new developments issued by the Information Division, Mutual Security Agency, 1 Grosvenor Square, London, W.1., as part of the United States Information Service.

Improved Finishing Techniques for Farm Equipment

Farm machinery, perhaps more than any other type of machinery, requires a strong protective finish, since it must withstand the effects of varying atmospheric conditions as well as the corrosive action of fertilizers, manure, and chemical spraying compounds. A tractor assembled by Harry Ferguson, Inc., Detroit, Michigan, is finished with what many authorities consider the most advanced methods known in the U.S.

On the company's experimental farm, test panels were mounted on 30 deg. racks for atmospheric exposure. Other equipment was half immersed for long periods in fertilizers, weed killers, insecticides, and manure. From these tests, the company developed a finish reported to withstand the exposures common to most farm equipment.

The finish used, is a grey enamel which is purchased to specification, each batch being tested before being used, for colour, stability, drying time, gloss, flexibility, water and petrol resistance. The enamel is composed of an alkyd-type resin with a pigment of non-chalking rutile titanium oxide tinted with durable non-fading colour pigments. The enamel is ordered in three different types; brush or spray for air drying; brush or spray for infra-red drying; and dip for infra-red drying.

The steering gear assembly, the lift cover assembly, and the tractor casting are coated with an oil-resistant primer. This primer is tested before use with the same thoroughness as the enamel. For example, the hot oil test consists in immersing the panel coated with primer in SAE No. 80 transmission oil at a temperature of 200 deg. F. for 200 hr. The panels withstood this test without evidence of wrinkling, blistering, or softening of the film.

Most of the sheet metal parts are finished first with one coat of a flash-type primer which consists of an alkyd-type resin with a pigment composed of iron oxide and zinc chromate. This primer is also thoroughly tested, the emphasis being put on drying time. Due to production limitations, drying time is most important, since the primer must dry in air in a maximum of 5 min. when applied to the panels at a temperature of 180 deg. F.

In the production of this tractor, three separate and independent paint lines are used, as follows: a chassis line; component parts line; and a detail-part dip line.

(*Automotive Industries*, July, 1952.)

A New Plating Bath

A new type of organic plating bath—developed by the National Bureau of Standards, Washington, District of Columbia—electrodeposits aluminium at room temperature. It is expected to find important uses in electroforming and for the application of thin protective coatings. It produces a dense, pure, ductile coating. The new bath is also being studied for the possible deposition of molybdenum, tungsten, titanium, and zirconium.

The bath is prepared by adding either lithium hydride or lithium aluminium hydride to an ethyl ether solution of anhydrous aluminium chloride. The ether should be anhydrous and alcohol-free. The concentration of the aluminium chloride is not critical, and may vary from 1 to 4 molar. Current densities may be as high as 4 or 5 amps. per sq. decimeter. If thick deposits are required, the current density should not be greater than 2 amps. per sq. decimeter.

The bath used for the experiments was hermetically sealed, with anodes of aluminium passing through the lid, the objects to be plated being introduced and removed through a central hole which is ordinarily kept closed with a rubber stopper.

No agitation of the bath is necessary. In fact, a quiescent bath is advantageous, because the sediment from the anodes settles to the bottom of the vessel, making bagging of the anodes and filtration of the solution unnecessary.

It is vital to use the correct amount of lithium hydride; if the content is too low, the deposits become hard, brittle, and gray. Ordinary deposits, 0·01 in. or more thick, are visibly crystalline; but this effect can be reduced somewhat by adding a small amount of dichloroethyl ether. Pitting, which frequently occurs in aqueous baths, is practically non-existent in the ether bath.

(*Steel*, 9th June, 1952.)

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ANALYTICAL CHEMIST (Junior) required for works laboratory in North London area. Graduate or equivalent. Wide scope of materials and problems, and excellent opportunity for advancement. Write Box No. 64, INDUSTRIAL FINISHING, 157 Hagden Lane, Watford, Herts.

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CHEMIST (Graduate or equivalent) required by large North London engineering company, to work on problems associated with the electroplating of metals and pretreatment processes. After initial training the selected applicant will be expected to carry out investigations to improve existing metal finishing techniques, etc. Write Box No. 65, INDUSTRIAL FINISHING, 157 Hagden Lane, Watford, Herts.

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CHEMICAL ASSISTANT required in electroplating laboratory in the North London area, to work on problems associated with electroplating and chemical finishing processes. Inter B.Sc. standard with some industrial experience desirable. Write Box No. 66, INDUSTRIAL FINISHING, 157 Hagden Lane, Watford, Herts.

APPOINTMENT VACANT

VACANCY IN WEST LONDON FACTORY for lady chemist for research work dealing with rust preventatives and metal-cleaning compounds. Applicants please furnish details of qualifications and past experience.—Box No. 67, INDUSTRIAL FINISHING, 157 Hagden Lane, Watford, Herts.

WOODWORKING MACHINERY

THE Anglo-American Council on Productivity Report on this subject has recently been issued, and the following comment is made under the heading "Painting and Finishing":

The finish of the final product was reasonable, but was always below that of the generally accepted British standard. Several methods of painting were seen, but in general they did not differ from normal British woodworking machine tool practice. In one, "hot lacquer" paint was used to facilitate spraying to avoid tears and shorten the drying period. In another, small parts suspended from an overhead travelling conveyor were sprayed and then passed to the assembly shop, passing at one stage through an "infra-red" stove. Outside the woodworking industry instances were seen of electro-static detearing and automatic conveying of parts through the degreasing, painting, stoving and cooling stages, where paint was pumped through pipes, above, below and at the sides of the conveyor through nozzles, and the surplus paint returned to the water tank at the bottom of the spray booth.

Most firms admitted that prevention of rust was a problem, especially if the finished product was destined for the tropics. It seemed that each firm had used a different brand of anti-rust solvent and that each was satisfied with its choice.

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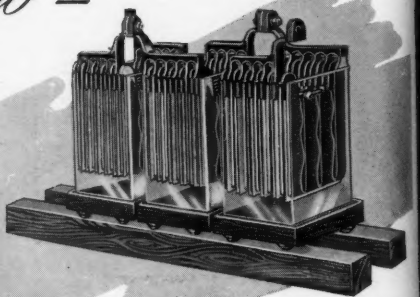

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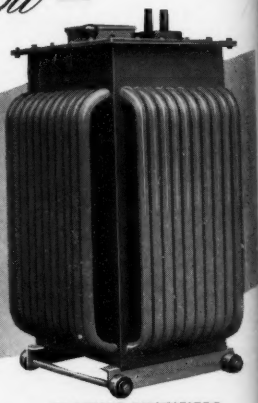

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